THE WELDING ENGINEER

DECEMBER, 1950

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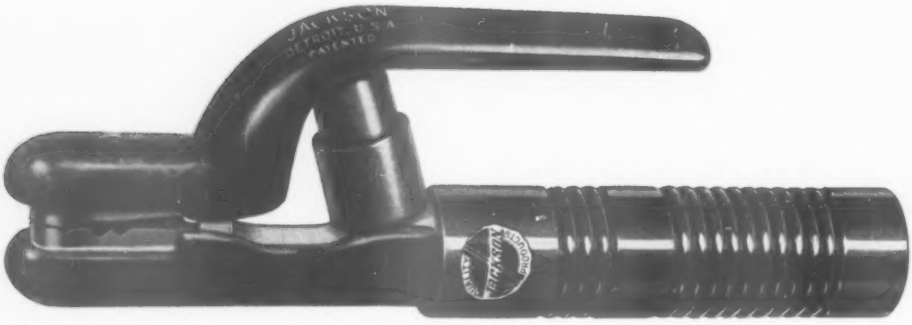
A McGRAW-HILL PUBLICATION



MODEL

A·W

Takes Electrodes including ¼"
300 amps. • 9¼" long
WEIGHT 14 OZ.

Wherever a lightweight holder is preferred, you will find one of these two holders on the job, doing 300 to 400-amp. work with the greatest ease, with only a minimum of fatigue.

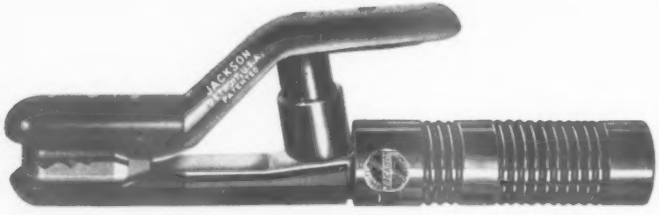
Tongs are made of lightweight metal alloy to which the cable must be mechanically connected.

Jaws are of Mallory metal, and are easily replaced to give added life to the holder.

Jaw Insulators, of the Jackson crown and channel type, now many times stronger, also insure longer, trouble-free service.

They have improved, *yoke-type pivoting* device which makes them easier to knock down and assemble.

JACKSON *Featherlight* ELECTRODE HOLDERS



MODEL

A·5S

Takes Electrodes including 5/16"
400 amps. • 11⅛" long
WEIGHT 21 OZ.

Call your Jackson distributor for Jackson Electrode Holders, Ground Clamps and Cable Fittings, Eyeshields, Safety Goggles

QUALITY JACKSON PRODUCTS

JACKSON PRODUCTS

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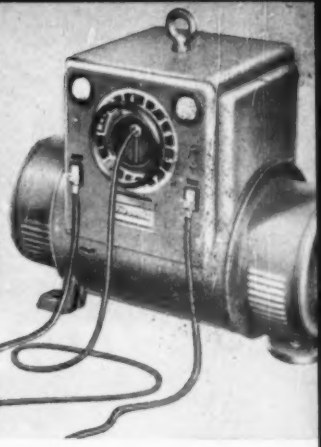
THE WORLD'S LARGEST MANUFACTURER OF ELECTRODE HOLDERS

"Remote control" with a HOBART

Speeds up production and cuts costs too!



Equip with HOBART welders!
Save space, time and money, using its exclusive remote control

The HOBART 200 amp. Gas Drive with 1 K.W. D.C. Auxil. Power

It's simplified: Finger-tip remote control of arc welding current at or away from the machine, assures you of better quality welding at lower cost because of increased production speeds. Especially is this true on production or construction work in hard-to-get-at places.

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Long life—rugged construction. The performance-proven design and liberal use of copper, steel and highest quality materials means one important thing—day-in-and-day-out dependability—a welder that's ready to go anywhere, at any time, and do a job second to none. That's why it will pay you to investigate HOBART Arc Welders today.

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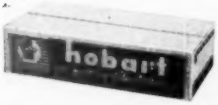

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FIRM _____

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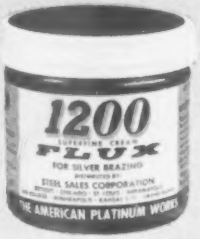

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THE WELDING ENGINEER

THE WELDING ENGINEER, *with which is combined The Acetylene Journal*

A McGRAW-HILL PUBLICATION

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DECEMBER, 1950

COVER: *Studs are end welded to plate used in the bottom section of a Westinghouse power transformer (see page 38). Photo courtesy Nelson Stud Welding Div., Morton Gregory Corp.*

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800% faster weld removal with 3M Abrasive Belts

Century Electric combines grinding and polishing into one operation

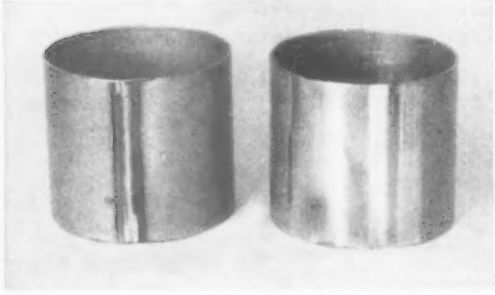
Century Electric Company, at St. Louis, Mo., formerly used a combination of grinding wheels and set-up wheels to remove butt welds from cold-rolled steel electric motor shells. Their 3M Methods Engineer pointed out the advantages of handling this operation with backstand belt equipment.

Look at these results!...

Hourly Production jumped from 15 to 125 pieces
A Smoother, More Attractive finish on each seam
One Operation Eliminated, handling time cut

This unusual saving at Century Electric illustrates the speed and cutting power of abrasive belts, and their ability to remove excess weld at a lower unit cost.

There's a 3M representative in your locality, who can survey your grinding and polishing operations, and point out ways to raise your production and cut your unit cost. Why not call him in today and let him show you how your present equipment can be quickly converted to abrasive belts at a minimum cost.



SMOOTHER FINISH for these motor shells in a single grinding pass. One whole operation is eliminated and operators find this new method faster, safer, and less tiring. 800% gain in production speed with a smoother, more attractive finish.

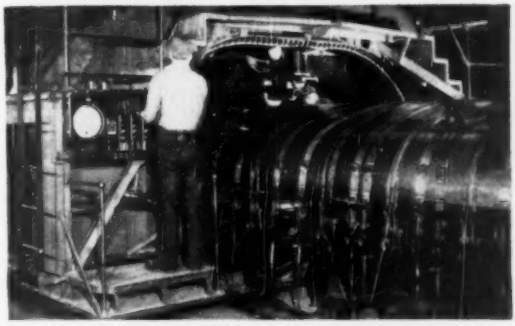
Made in U.S.A. by MINNESOTA MINING & MFG. CO., St. Paul 6, Minn., also makers of "Scotch" Brand Pressure-sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-Slip Surfacing, "3M" Adhesives, General Export: Durex Abrasives Corp., New Rochelle, N.Y. • In Canada: Canadian Durex Abrasives Ltd., Brantford, Ontario.

LOOK! SPEED INCREASED PRODUCTION IMPROVED

with G-E electronic resistance welding controls

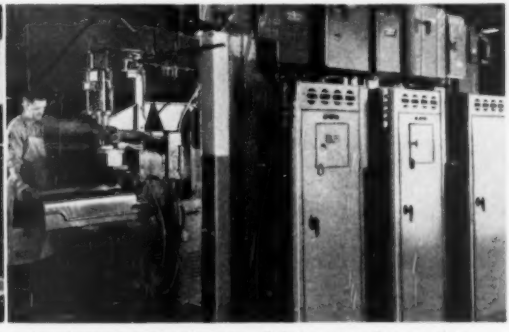
4 companies report outstanding savings

Weld faster, cleaner, and with less kva demand. Weld new alloys. There are G-E electronic controls to help *you* improve production, improve *your* product, reduce costs just as they have done in the cases described here. Take advantage of the newest improvements and developments in G-E control—the wide experience of our welding control specialists. Together with your welding machine manufacturer, they'll help you solve production problems. Write your nearest G-E office today for more information. *General Electric Company, Apparatus Dept., Schenectady, N. Y.*

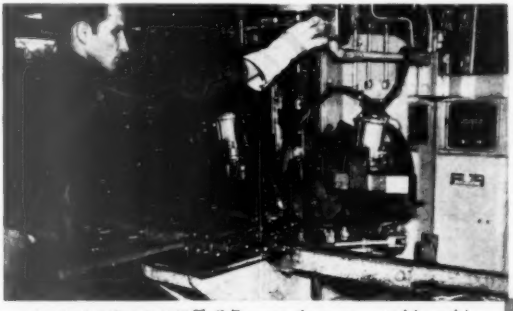


Fabrication speeded 100% . . . rejects reduced 75% Standard G-E electronic welding control available from stock and easily adapted to any resistance welding requirement can often result in improvements such as these at Pullman-Standard Car Manufacturing Company. Bulletin GEA-4699.

New Alloy Welded—just .007 inch thick G-E Thyratron spot-welding control is used at the Elgin National Watch Company on a Dura Power mainspring. Elgin reports, "Thanks to G-E control, work is easy, accurate, and production is high." Bulletin GEA-4175A.



One Production Step Eliminated G-E slope control so greatly reduced metal expulsion on engine hoods produced by City Auto Stamping Company that an expensive polishing operation was eliminated, quality retained. Bulletin GEC-534. Additional application stories in GET-1892.



Production Speeded 25% G-E nonsynchronous control is used in welding steel window frames at Copco Steel and Engineering Company. New control has been simplified, takes less space, requires less maintenance, timing is electronic. Bulletin GEA-4726.

REMEMBER . . . GOOD resistance welding depends on GOOD electronic control. When you buy insist on G-E. . . . longest in the business with the most complete line of resistance welding controls.

For quick and easy training of operators ask your welder manufacturer, power supplier, or the nearest G-E office for a FREE showing of the sound, all-color movie, "This is Resistance Welding," a General Electric More Power to America film.

GENERAL ELECTRIC

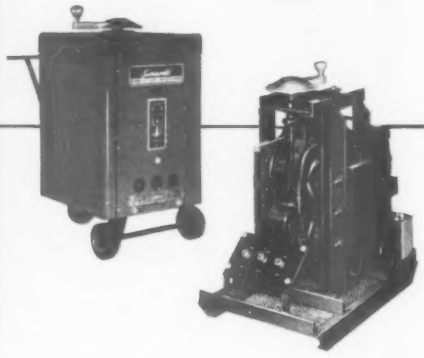
645-53K

4 exclusive reasons why

Sureweld® is the BEST

COMPARE

Feature for feature the Sureweld A-C Arc Welder will surpass any other make . . .



9 INDUSTRIAL MODELS

5 SHOP MODELS

	NEMA Rating			Welding Range				
Model	Amps.	Volts	Duty Cycle	Min. Amps.	Max. Amps.	Open Circuit Volts	*Open Circuit Voltage Reducer	Power Factor Correction
500RP	500	40	60%	25	700	80	Yes	Yes
500RPX	500	40	60%	25	700	80	No	Yes
400RP	400	40	60%	25	520	80	Yes	Yes
400RPX	400	40	60%	25	520	80	No	Yes
300RP	300	40	60%	25	450	80	Yes	Yes
300RPX	300	40	60%	25	450	80	No	Yes
200RP	200	40	60%	25	300	80	Yes	Yes
200RPX	200	40	60%	25	300	80	No	Yes
200RX	200	40	60%	25	300	80	No	No
30G	200	30	50%	25	260	75	No	No
30GP	200	30	50%	25	260	75	No	Yes
20G	150	30	50%	20	190	75	No	No
20GP	150	30	50%	20	190	75	No	Yes
10GP	180	25	20%	20	180	75	No	Yes

*Reduces open circuit to 40 volts when not welding.

WELDER YOU CAN BUY

No welder tops the Sureweld A-C Arc Welder for value! Dollar for dollar the Sureweld delivers *more* quality, *more* features, *more* solid performance.

You can *prove* it to yourself! Put the Sureweld into side-by-side competition with any other welder you can name—and watch Sureweld *out*-perform, *out*-economize, *out*-last the others.

Clip and mail the coupon below to get a free copy of the illustrated booklet, "New Era in Welding," giving *additional* reasons why Sureweld is *really* today's best buy! And if you'd like a demonstration, without obligation, put a check-mark, in the box.

NO OTHER WELDER HAS THIS UNIQUE 4-COIL TRANSFORMER

The "heart" of any welder is the transformer. The Sureweld's exclusive and different patented 4-coil transformer, with the movable shunt, gives the controlled power that means faster burn-off, proper penetration and correct breakdown of hard-to-handle alloy rods.

GUARANTEED—MADE TO NEMA SPECIFICATIONS

HIGHEST OPEN CIRCUIT VOLTAGE

Adequate open circuit voltage permits the ready use of heavy-coated, alloy and low-hydrogen electrodes, with ease in starting, ease in holding a steady arc. No other welder beats Sureweld's 80 volts. But personnel are safeguarded by a voltage reducer that automatically cuts current to 40 volts whenever the machine is not actually welding.

GREATEST TRANSFORMER CAPACITY

No welder can match Sureweld for extra pounds of copper and laminated iron. That's why Sureweld has *no fan*. There's enough transformer capacity to deliver peak output without overheating—yet *without* forced ventilation. No chance of the transformer burning out because of fan failure. This means extra long life for your Sureweld, and freedom from costly maintenance.

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Sureweld's exclusive and unique 4-coil transformer design with movable magnetic shunt gives *truly* stepless control, *really* smooth performance, and *uniformly* fine welding characteristics at all amperages. Movable shunt makes full-range control infinitely variable, and provides exact heat desired instantly at the turn of the handwheel.

WIDEST CURRENT RANGE

The Sureweld Industrial Models have the broadest current range of all the welders on the market—ranging from 25 to 450 amperes, for example, in the 300RP Model with a 300-amp. rating. This means real arc stability for welding at low heats, and plenty of push for production work on heavy sections. Yet, you pay no more for Sureweld.

Test the Sureweld in your own plant or shop

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( ) I would like a demonstration, without obligation.

Name_____

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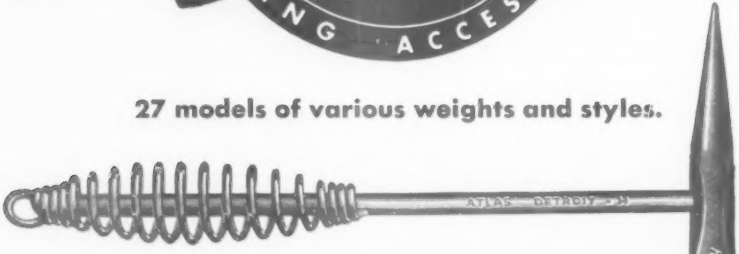
Good tools make better workmen and produce better work

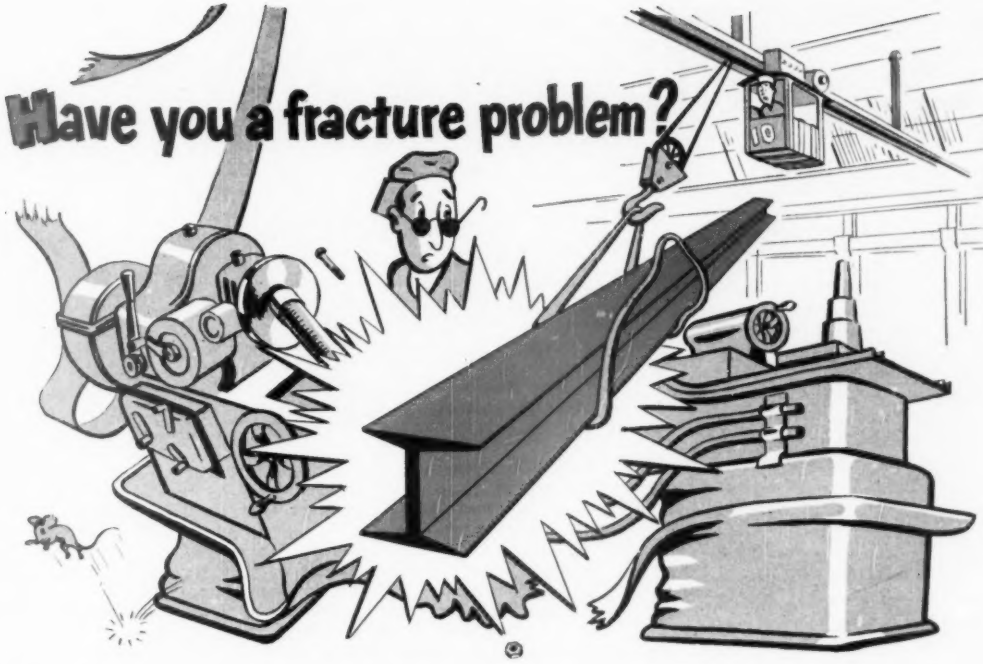
27 models of various weights and styles.



Ask your local welding supply dealer to show you the Atlas line.

Atlas WELDING ACCESSORIES CO.
707 E. LEWISTON AVENUE FERNDALE 20, (DETROIT) MICH.

Have you a fracture problem?



don't worry—weld it in a hurry—

with REVERE #456 BRONZE WELDING ROD

SAVES 3 WAYS

THE "FLAME-TESTED" ROD IN THE DISTINCTIVE RED, WHITE AND BLUE PACKAGE

You not only save time when you use Revere #456 Low Fuming Rod for repair and maintenance work, but you save on fuel and "clean-up" costs, too. Here's how:

1 **FASTER PREPARATION**—Time is saved in preparing the parts to be joined as the high strength of Revere #456 permits wide assembly tolerances, yet provides strong, neatly-finished joints.

2 **NO HIGH PRE-HEATS AND POST-HEATS**—You save on the time and fuel costs involved in pre-heating because the low melting point of Revere #456 (about 1600°F.) reduces the need for high pre-heats and post-heats.

3 **LESS "CLEAN-UP"**—Because it is low fuming Revere #456 enables you to get more accurate placement of the weld metal and thus saves on "clean-up" costs.

Next time you have a fracture problem in cast or malleable irons, wrought iron, cast or wrought steel, cast or wrought bronze, try Revere #456. Once, you've worked with this "flame-tested" rod you'll see how it cuts costs, saves time and gives better results. Make Revere #456 prove itself. Order a package today.

Other Revere Welding Rods are: Revere Bronze 380, Manganese Bronze, Herculoy, Phosphor Bronzes, Brass (Brazing Rod) Silicon Deoxidized Copper and Electrolytic Copper. All come in 100-pound cases or in 25-pound cartons, net weight, and are stocked by Revere Welding Rod Distributors in all parts of the country. Write for folder giving technical data.

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Sales Offices in Principal Cities, Distributors Everywhere.

LINDE'S News of Metalworking

$$$$$$ Saved in Removal of Blast-Furnace Salamander

Oxy-acetylene powder-cutting eliminated a nasty job in one steel mill not long ago. The problem was to remove a salamander in a blast furnace so that the hearth could be replaced without disturbing the upper lining.

After discussing the problem with a LINDE Process Service representative, the company decided to use powder-cutting with an OXWELD C-60 Blowpipe to cut up the salamander.

Only three days were required for the cutting. Production time saved over any other removal method was estimated to be two weeks. $500,000 worth of iron can be produced in two weeks' time.

Most important from the mill's standpoint was the fact that the upper brickwork was not damaged. Damage from other methods of removing the salamander could run as high as $300,000 worth of brickwork.

The OXWELD C-60 Blowpipe is specially designed for extra heavy cutting. And when powder-cutting is used refractory oxides are no problem.

What's News

► Of special interest to quarry men is LINDE'S Jet-Piercing blowpipe which can pierce holes to a depth of 5 ft. in hard and abrasive rocks and ores. This economical, speedy method makes blast holes in granite at a rate of 22 to 25 ft. per hour.

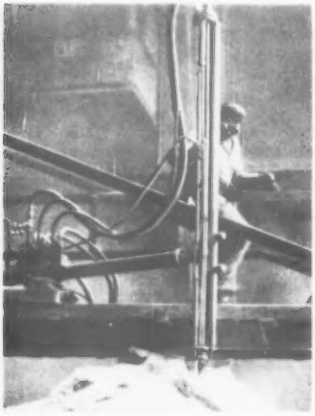
► One pipe manufacturer has produced a record seventy miles of 24-in. pipe (12,990 tons) in one month with the help of UNIONMELT welding.

► By using oxy-acetylene flame-cleaning, a foundry has cut the time required to clean slag from the center of their 20-in. castings from about 6 hours to 5 minutes.

► When television inspectors rejected ten thousand tubes because of cracks in the spun chrome steel bases, LINDE engineers showed the tube manufacturer how to make repairs by HELIARC welding. A saving of $8.00 per tube was accomplished.

LINDE Service Doesn't Cost -- It Pays!

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
Offices in Other Principal Cities
In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto



Powder-cutting is used for many jobs in addition to the salamander cutting described above. It is ideal for reducing large masses of cast iron.

"Lost Heat" Reclaimed in 18 Hours

When a full 75-ton heat of steel was recently lost through the bottom of an open-hearth furnace, it was reclaimed in only 18 hours. An OXWELD C-60 Cutting Blowpipe quickly cut the metal to handling size. Using older methods this would have been a three-day task.

Two full days of operating time were saved by returning the furnace to service in 18 hours. Actual cutting time was only five hours.

And the expense? Total cost for materials amounted to not more than $100.

For further information about powder-cutting or other LINDE processes, call or write our nearest office. We'll be glad to give you more details.

Slag and cinder inclusions are no problem for the C-60 and powder-cutting. Spill sections as thick as 6 ft. have been severed by continuous cutting.

The terms "Linde," "Oxweld," "Unionmelt," and "Heliarc" are registered trade-marks of Union Carbide and Carbon Corporation or its Units.

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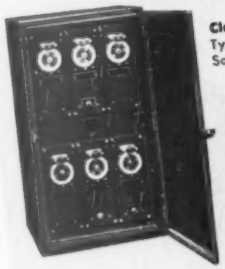

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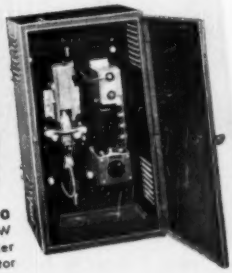
Type TCS-10 NEMA 5B
Safront Sequence Weld Timer



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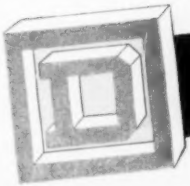

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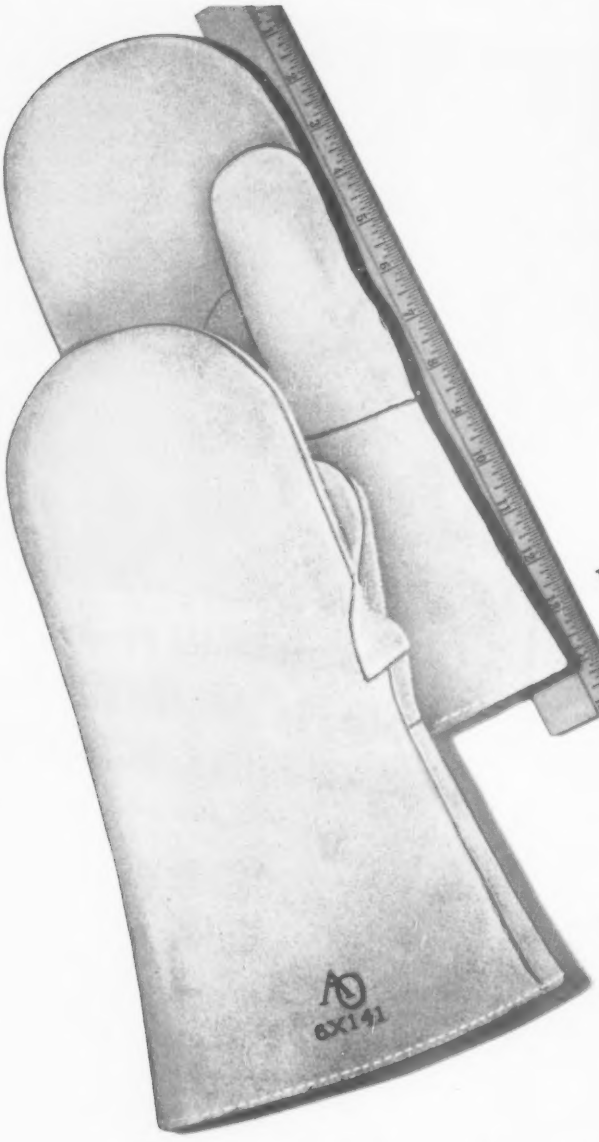

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I should like to thank the welding engineers and the welders of America who have so wholeheartedly supported our efforts. I should also like to renew our pledge of never-ceasing research and continued production expansion in the development of rods, electrodes and fluxes that will bring even greater advances in increased speed, safety, and savings to your welding operations.

Cordially yours,
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President

Forty-four years ago, my father began research on a method of joining metals at heats below the melting point of the base metals involved. Later on, I had the privilege of continuing this work with him to the point where we perfected a new metal-joining process utilizing an entirely *different* kind of welding rods and electrodes that *yield radically new results.*

To distinguish our new line of filler metals, we coined the phrase, "Low Temperature WELDING ALLOYS", which is *registered* in the U.S. Patent Office as a *Trade Mark* of this company.

When, in 1940, these vastly improved techniques were introduced to American industry, it was my privilege to establish and to guide a basic policy that was to keynote our activities for the next decade: "CONTINUOUS RESEARCH AND SERVICE".

Today, in our tenth year of uninterrupted progress, the results of that unceasing determination to overcome the failures of old-fashioned, high-heat welding methods may be measured in many ways.

One gauge of effectiveness lies in the long list of EUTECTIC's developments that have become veritable "milestones" in the advancement of American welding techniques:

✓ The first nickel-bearing, copper zinc welding alloy. (U.S. Patents No. 2,279,282 and 2,279,283)

✓ The first nickel-bearing, copper zinc welding alloy containing silver. (U.S. Patent No 2,279,284)

✓ Truly color-matching process for welding cast iron at low heat. (U.S. Patent No. 2,288,869)

✓ Low-melting, high silicon content, aluminum joining alloy for use with specially compounded flux. (U.S. Patent No. 2,481,053)

✓ Low-melting flux specially compounded for use in the welding of ferrous metals. (U.S. Patent No. 2,479,798)

✓ Covering of welding rods with special metallic film. (U.S. Patents No. 2,359,613 and 2,410,850)

✓ Fully machinable, low-amperage electrode for welding cast iron. (U.S. Patent No. 2,410,850)

✓ High-strength electrode for welding aluminum without spatter or fumes. Trademarked: "EutecTrode 2101." (U.S. Patent Pending)

✓ High Quality fluxes used in conjunction with gas rods and electrodes for the welding of aluminum, aluminum alloys and magnesium. Trademarked: "Eutector."

✓ Series of low-melting alloys for *color-matched* joining of aluminum, brass, bronze, copper, and nickel alloys.

✓ AC-DC cutting electrode that cuts, pierces, chamfers *all* metals without oxygen. Trademarked: "CutTrode."

✓ Mass-produced 'contact-type' electrode for swifter, safer welding of steel. Trademarked: "Hand-O-Matic."

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These are only a few out of the full list of over 150 job-proved alloys our company offers today.

Today, as we start our second decade of service to American Industry, EUTECTIC Low Temperature WELDING ALLOYS are specified in over 78,000 plants throughout the nation!

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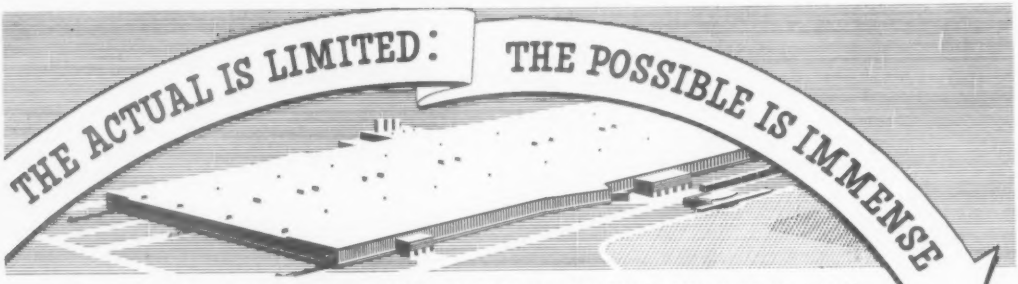

NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

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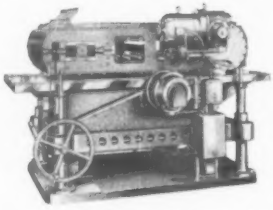
MACHINE BUILDER CUTS DEFLECTION 80%

BASIC objectives of increased rigidity and greater machine accuracy are today being achieved at lower cost with welded steel designs. As illustrated in the redesign of the Facing Planer for the Porter Machinery Company, the present welded steel table when supported on three corners indicates a deflection of only .014" where as the former cast construction sagged as much as .070". Simultaneously, a reduction in weight from 410 lbs. to 320 lbs., made possible by the increased stiffness of welded steel, enables a tolerance of .001" to be maintained on surface flatness.

How to Steel Design With Welding is presented in the new 9th Edition "Procedure Handbook of Arc Welding Design and Practice." Contains latest data on machine design together with cost figures. Price only $2.00 postpaid in U.S.A.; $2.50 elsewhere.

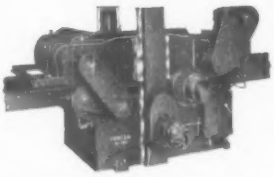
Left: Checking table deflection at Porter Machinery Company, Grand Rapids, Michigan. Center: Unsupported corner of former 36" planer top sags .070". Right: Present welded steel table deflects only .014".

the ACTUAL



Former Design. *Had heavy base serving no other purpose than to unify planer.*

increasing the YIELD



Present Steel Design *has rigid box-type base . . . eliminates costly weight.*

the IMMENSITY of the POSSIBLE HIGHER MACHINE ACCURACY

SEE HOW WELDED STEEL CUTS MATERIAL NEEDED

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THE WELDING ENGINEER

ESTABLISHED 1914 DECEMBER, 1950

An Honest Day's . . .

CAN YOU UNDERSTAND the thinking of those whose program calls for the spreading of work by slowing down production? I can't. It doesn't make any sense whatsoever, either in peace or in war.

During World War II, I was shocked at the reluctance of many shipyard weldors to do an honest day's work for an honest day's pay. It is inconceivable that workers would deliberately lay down on the job, knowing that soldiers might die for lack of the supplies they (the workers) were supposed to furnish. Yet they did, in many instances. And after the war, in the five-year interlude of peace and prosperity, the prevailing attitude was, "Grab all I can get; do as little as I have to."

Now war is here again, and defense production is actively underway. Yet the same mental attitude still prevails. No one wants to work any more than he has to. What's happened to ambition?

Henry Ford, George Westinghouse, Thomas Edison and others whose genius has brought a better and more abundant way of life to us all were willing to accept responsibility, to work long hours and to risk all of their capital backing their own ideas. But that was the period of the Horatio Alger school of business philosophy, and government doesn't believe in Horatio Alger today. What it does believe in is to step on the man who shows a little initiative.

It's possible that individuals may have as much ambition as they ever did, but the prevailing social climate is such that they can't exercise it. A beautiful example occurs from England, where a weldor was recently fined for doing too much work. Yes, that's right: doing too much work.

John Philpots, the weldor concerned, is 20 years old and works in a factory at Birmingham. The rules of his union limited his earnings to 57 cents an hour. But Philpots was ambitious, and he was on piece work. He worked just a little harder than the next fellow and at times stepped up his production rate so that he was earning 60 cents an hour.

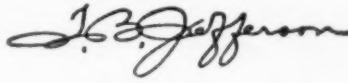
In eight weeks, young Philpots had earned $4.48 more than the 57-cent rate allowed. For this grave offense, his union fined him $5.60, wiping out all his excess earnings. Philpots failed to see the justice of that, and he told his father. John's father thought it was a rotten deal, too. John being under age, his father is suing the unions. He has advised Prime Minister Attlee that he will take legal action to get back the $5.60 and to restrain the union from levying any more fines if John keeps on working hard.

An editorial in the London *Standard* says that the father's brave defiance could well be one of those small acts that change history. "The case challenges one of two fundamental evils that afflict the life and welfare of Britain," the *Standard* declared. "The first evil is socialistic controls. The second, which the Philpots have now put in the issue, is restrictive practices maintained alike by workmen and their employers in an organized form, by trade unions on the one hand and by cartels, rings and price fixing organizations on the other.

"These practices are the legacy of days that are gone forever, but the habits do not die. The Philpots have hit out against restriction. Their own strength is small, but if they have good grounds for their fight, it is the vital interest of every citizen to lend them support."

At home as well as abroad, there has been a tendency to level production, income and living standards by dragging the best worker down to the level of the slowest and most stupid. This cockeyed equalitarian theory didn't work even in Russia (where they are now on piece work, with greatest rewards for greatest production); it may be an excellent method of charity, but it never has built and never will build a nation.

Had Ford, Westinghouse, Edison and the others like them been willing to take charity instead of responsibility, we would still be riding around in horse-drawn buggies and trying to read by gas light or candles. Maybe we could do worse than go back to Horatio Alger and the bound-to-win school. Certainly what we need is greater productive effort on the part of everybody.



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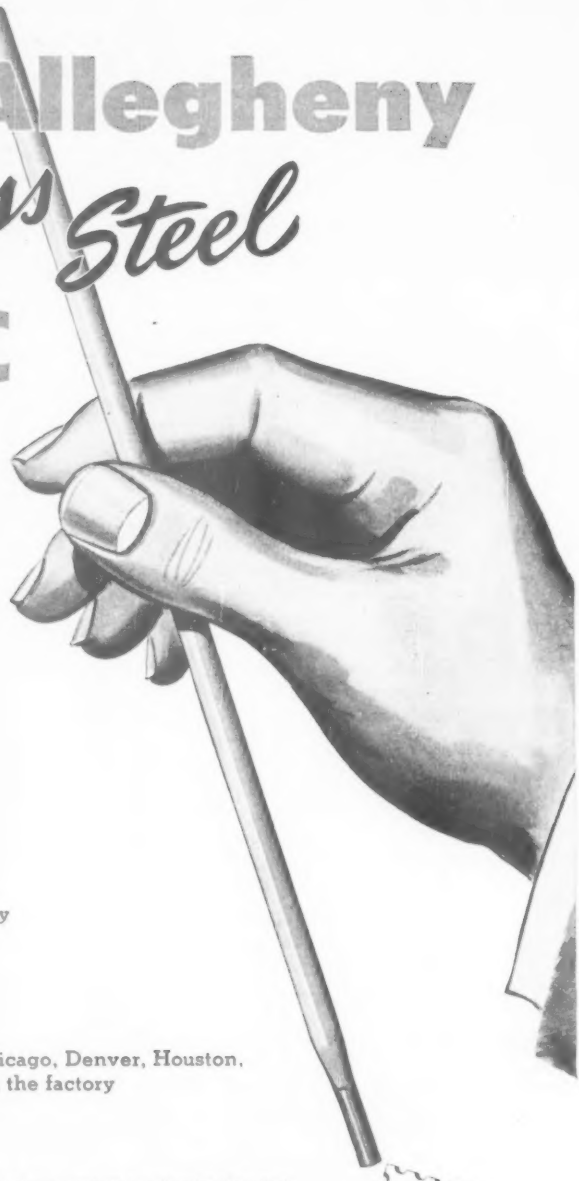

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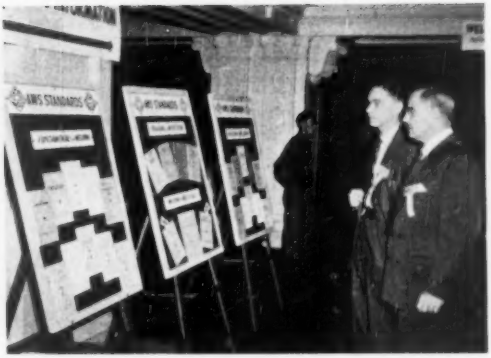
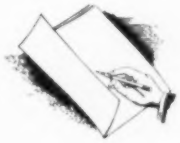
REGISTRATION DAY. Official total was 1,375, down a little from last year but still a good attendance



LOBBY EXHIBITS attracted C. D. Evans (left) and J. Lyell Wilson of the Technical Activities Committee

Convention Notebook



What happened in Chicago? To find out, read this play-by-play account of the big annual AWS meeting.

BY CLYDE B. CLASON

THE 31st annual meeting of the American Welding Society (Hotel Sherman, Chicago) got off to a flying start on Sunday afternoon Oct. 22 with one of the best President's Receptions it has ever been this writer's privilege to attend. All honor to Jack Roscoe, the chairman, and to members of the President's Reception Committee! And while we are tossing bouquets, one should certainly go to Homer R. Morrison, chairman of the National Convention Committee. There never was a smoother running convention and although Morrison modestly refuses to take any credit for it, his fine hand was everywhere in evidence. It's gratifying to learn that Homer will be holding the same office for next year's convention in Detroit.

Unfortunately, a few brickbats seem to have got mixed up with the bouquets. The convention was too heavily programmed—too many papers, too many technical sessions, too many conflicting special events. By a bad mistake in scheduling, the only free period allotted to visit the Metal Show was on Friday afternoon when the exhibition was all but over. But these criticisms pertain to matters that can and probably will be rectified next year.

Attendance was disappointing, too. Official registration of 1,375 was down 400 from last year's Cleveland registration of 1,775. But this year a registration fee was levied, which may mean that the drop was in registration rather than in actual attendance. Certainly the technical sections seemed full.

Applied Welding Symposium

Among the special events deserving an A-1 rating, we would definitely put the symposium sponsored by the AWS Technical Activities Committee. Under C. D. Evans, of International Harvester Co. and chairman of the Technical Activities Committee, and S. A. Greenberg, technical secretary of AWS, the panel discussion moved with the precise timing of a radio script.

In addition to Evans and Greenberg, the panel of experts included: J. J. Chyle, director of welding research of A. O. Smith Corp.; A. N. Kugler, Air Reduction Sales Co.; Robert W. Clark, General Electric Co., and J. Lyell Wilson, consulting engineer. Chairman Evans outlined the theme of the program, which was built around the four basic subdivisions of applied welding engineering; namely, (1) design; (2) materials; (3) workmanship and (4) inspection. Chyle covered the design part of the program, Kugler materials, Clark workmanship and Wilson inspection. All four talks centered on the same three products: an enclosure box for electrical switches (spot welding), a motorcycle frame (induction silver brazing) and a building structure (arc welding). Co-chairman Greenberg then tied the threads together by showing how the same four factors of design, materials, workmanship and inspection apply to all types of weldments.

Of the 200 people at this Tuesday evening session, 165 returned opinion cards. The voting: 82 excellent, 64 good, 4 bad and 15 no indication.

It's your reporter's opinion that this program is much too good to be given just once and then forgotten. The script should be printed and distributed to local AWS sections so that each of them can re-enact the symposium with six local men as participants. It would make a darn good program for any local meeting.

Resistance Welding Panel

The panel discussion on recommended practices for resistance welding, held on Monday afternoon in conflict with three simultaneous technical sessions, didn't come up to the high mark of the applied welding engineering symposium. The personnel of the panel was of top-grade calibre, but the audience was sluggish and

PRESIDENT'S RECEPTION was one of the best ever staged. The Sherman ballroom was packed to capacity

RECEPTION LINE. The officers doing the greeting are O. B. J. Fraser, Harry Pierce and C. H. Jennings

did not participate to the expected degree. Too bad, because there was a good opportunity to learn something from such experts as: Julius Heuschkel, Wilson Scott, R. T. Gillette, W. J. Wilson, J. B. Welch, R. M. Wilson, Jr., J. J. MacKinney and E. A. Bussard. All credit to these men, who did not fail in their part of the program.

Educational Lectures

Another disappointment to the writer was the educational lecture series, held from 4:30 to 6:00 p.m. on Monday, Tuesday and Wednesday afternoons. No reflection is intended to be cast upon the men giving the lectures, who knew their stuff and how to present it; the trouble was that the ground just couldn't be covered adequately in the brief time allotted to it. Each of the three lectures on non-ferrous metals could very well have been expanded into a week's course.

As an example of what is meant by the above criticism, G. O. Hoglund, who took the lecture on aluminum, had to cover the welding of aluminum by 22 welding processes as well as discuss the physical and chemical properties of various alloys and the metallurgical effects of welding. Hoglund, who is with the Aluminum Co. of America, had to strip his subject down to the bare A-B-C's because of limited time.

The same difficulty was experienced by J. R. Hunter, who gave the lecture on copper, and R. M. Wilson, Jr., who gave that on nickel. Hunter is manager of the welding section, research department, Revere Copper and Brass Co., Inc., and Wilson is welding engineer with International Nickel Co., Inc. No better qualified lecturers could possibly have been selected than Hoglund, Hunter and Wilson, and it is a pity that they had to work against time and at the tag end of the day when listeners' minds were pretty generally fatigued.

Hunter revealed that submerged-arc welding of copper is a promising new development. Sound welds can be produced by this process, he said. Wilson limited his talk to the high-nickel alloys, those containing over 50% nickel. These many alloys may be divided into three main groups: (1) pure nickel and nickel-carbon; (2) nickel-copper alloys such as the various Monels and (3) nickel-chromium-iron alloys, including Inconel, Inconel X and Inconel-clad materials. All of the high-nickel alloys have high melting points, in the range from 2,300-2,600 F.

Adams Lecture

The 1950 Adams Lecture was ably delivered by Charles H. Jennings, engineering manager of the Westinghouse welding department at Buffalo, and first vice-president of the American Welding Society for 1950-1951. Jennings is the author of more than 30 articles on welding and has written two books: *How to Weld 29 Metals* and *50 Lessons in Arc Welding*. His subject was that elusive matter of the welding characteristics of d-c welders. It is the dynamic characteristics that count, said Jennings, the surge currents or overshoots rather than the static volt-ampere curve. A reasonable amount of current overshoot is desirable and has bearing on the ability of the welder to maintain an arc at low-current densities.

The Technical Sessions

By this time the ground has been well cleared for the main business of the convention—its 24 technical sessions. As far as quality is concerned, most of the papers seemed to be up to the high standards set by previous years. As for quantity—well, 87 papers are entirely too many to cram into a single week, thinks this writer. The old proverb: "The mind can absorb only what the tail can endure," has distinct application here. Three papers with intervening discussion make a nicely rounded session; four papers are just one too many for the tail to suffer. Yet four seemed to be the norm at this year's meeting.

A most welcome innovation was the practice inaugurated at many sessions of keeping the lights on while slides were being shown. The slides didn't seem to suffer much in visibility, and the lights made it possible to take notes. Since, most papers are given in large part while slides are on the screen, the point is important.

Another innovation was the distribution of cards for balloting. The audience was requested to rate each speaker on his subject matter, slides and presentation. Dull speakers and dull papers ought to be weeded out if opinion-taking is continued regularly over the next few years.

Let's skim over some of the high-

DR. WENDELL F. HESS (left) receives Samuel W. Miller Memorial Medal from President O. B. J. Fraser

AT DESIGN LUNCHEON: A. F. Davis, George F. Nordenholt (the featured speaker) and Homer R. Morrison

lights, beginning with Monday morning and following through in chronological order until Friday noon.

Monday Morning

Monday was an all-day meeting with six technical sessions: weldability, resistance welding and surfacing in the morning; flame-hardening, research; arcs, electrodes and fluxes in the afternoon.

At the weldability session, the paper by Flanigan, Bocarsky and McGuire, a University of California research team, covered the influence of low-temperature cooling rates after welding on the ductility of arc welds in mild steel. The ductility of E-6010 welds was found to be strongly dependent on the rate at which the cooling weld approached room temperature. Rapid cooling makes for a non-ductile weld.

The Enzian-Salvaggio paper, on an investigation of the brittle behavior of mild steel plates, disclosed that the effect of nitrogen may not be as pronounced as is generally maintained.

In the resistance-welding session, J. Raymond Wirt, Delco-Remy Div. of General Motors Corp., discussed the development of out-of-the-ordinary production welding practices at the Anderson, Ind., plant. One product, a new style of horn, had 4½ years of designing, redesigning and testing, but the outlay of many thousand dollars was repaid in less than six months by the savings effected. Some 25 to 35 parts were eliminated by the use of welding.

Copper will weld to steel much better if the steel is zincplated, said Mr. Wirt. This development has opened the field to a number of new applications. In welding copper to copper by resistance methods, it is advisable to use a brazing alloy to get resistance to generate the welding heat.

In 1940, Delco-Remy had 40 resistance-welding machines; at present it has 150. They are used to replace soldered joints, to replace bolted or riveted joints, to replace copper-brazed joints, for hot upsetting to replace cold riveting and in turning out new designs made primarily for welding.

At the same session, Donald H. Fleig, American Electric Fusion Corp., discussed problems arising when tube mills are operated at present high speeds of 100 to 200 feet per minute. All the small variations found in lower-speed operation are greatly magnified and may lead to trouble.

The surfacing session, though jammed into the smallest room, was the best attended of the three Monday morning sessions. Papers were given by H. S. Avery, of American Brake Shoe Co.; O. E. Swenson, of U. S. Naval Engineering Experiment Station; Eldon C. Hurt, of Haynes Stellite, and H. E. Cable, of Lincoln Electric.

Mr. Avery's paper discussed characteristics of weld deposits from composite rods, made by enclosing granules of tungsten carbide in a mild-steel tube. The sheath tubing melts during welding and dissolves a portion of both tungsten and carbon to form a hard matrix that anchors the hard granules in place. However, the matrix is not a mere binder for the tungsten carbide, as is usually believed, but has important characteristics of its own. Surface roughness of abraded deposits depends both on initial granule size and on welding procedures. Abrasion resistance depends largely on the volume of undissolved carbides and is generally better for gas welds. However, arc-welded deposits have better hot-hardness properties at 1,200 F.

Mr. Hurt's paper described production hard-facing at high speed on parts intended for abrasive applications. He showed pictures of set-ups using multi-tip torches and heating heads in conjunction with conveyor lines and predicted much wider use of such practices in the future.

Mr. Cable contended that the arc is an economical and efficient means of doing certain types of surfacing (as distinct from hard-facing). The submerged-arc process has made it considerably easier to fabricate composite-metal parts. An example is the deposition of a stainless lining on the interior of a mild-steel tank. Under the heading of composite-metal fabrication, Mr. Cable also included the welding of dissimilar metals.

Monday Afternoon

The long-hairs got their innings during the afternoon sessions on research and on arcs, electrodes and fluxes. The latter session was featured by high-speed movies of the arcs in inert atmospheres: these showed the manner of metal transfer.

Practical production men probably preferred the flame-hardening session, where three good papers were given: by E. J. Cox, of Pittsburgh

CHARLEY JENNINGS, vice-president, AWS, did a very good job delivering the 1950 Adams lecture

RESISTANCE-WELDING panel. Front row, left to right: W. J. Wilson, Wilson Scott, E. A. Bussard, R. T. Gillette, J. B. Welch, R. M. Wilson, Jr. Back row: J. J. MacKinney, S. A. Greenberg and Chairman J. Heuschkel.

Commercial Heat Treating Co.; by J. J. Barry, of Air Reduction Sales Co., and by Milton Garvin and David Strauchen, of Cincinnati Milling Machine Co. The latter paper, presented by Garvin, discussed an interesting piece of equipment, also on exhibit at the Metal Show. This new flame-hardening machine employs a radiating pyrometer to control the heating temperature to precision values. A "Rayotube," located above the work being spun, extracts a small amount of radiant energy, which is amplified and used to measure the temperature. When the black needle on the pyrometer, indicating the temperature of the work at any instant, reaches the red needle at the preset temperature value, the flames go off and the work drops into the quench. With this piece of equipment, the temperature of the work can be raised at a rate as high as 500 F per second.

The proving ground for flame-hardening, thinks Mr. Cox, is in the plants of the country's commercial heat treaters. Unfortunately some plants have given flame-hardening a black eye by their use of hand methods and antiquated equipment.

Mr. Barry described a new torch for flame-hardening having a flow capacity of 600 cubic feet an hour of acetylene. Even this is dwarfed, however, by a second piece of new equipment, a water-cooled torch with a capacity of 2,250 cfh of acetylene. Using two of these giant torches, you can harden work up to as large as 30 in. in diameter. In general, each inch of diameter, requires a flow of 150 cfh of acetylene. The 600-cfh torch, therefore, will harden shafts up to 4 in.

Tuesday Morning

Tuesday morning sessions were on pipe fabrication, resistance welding and ship structure, the latter two subjects also continuing on into the afternoon. The pipe fabrication session was an especially good number and was attended by an interested and enthusiastic audience. Four papers were given.

N. L. Navarre, U. S. Naval Engineering Experiment Station, discussed procedures developed for welding various types of alloy steels used in today's superheated steam lines operated within the range of 950 to 1,100 F and up to 2,000 psi. Alloys tested were: ½% chrome, ½% moly; 1% chrome, ½% moly; 2¼% chrome, 1% moly; 4-6% chrome, ½% moly; 18% chrome, 8% nickel.

H. J. Irrgang, Jr., of W. K. Mitchell & Co., discussed the problem of slag entrapment in the welding of high-pressure, high-temperature alloy piping. Most of the slag collects in the undercuts at the side walls, he said, and the solution is a washed-weld technique instead of a series of beads. Irrgang's company also found it desirable to preheat to as high as 700-900 F and to weld under that preheat.

Test welds in forged-and-bored 347 steel piping were described by Roy W. Emerson, chief metallurgist of the Pittsburgh Piping & Equipment Co. This very heavy-walled piping was welded in three tests of columbium-stabilized stainless electrodes: manually by 19-9 cb and submerged-arc welded by 20-9 cb and 19-9 cb. The last test was the least satisfactory.

Piping of an altogether different nature was discussed by Horace Jackson, of Thompson Pipe and Steel Co., Denver, Colo. Thompson Pipe and Steel manufactures pipe for water conduits with diameters on the order of 6 to 7 ft. The trend today is toward longer and longer spans, with resulting savings in installation. The longest span, located near Cody, Wyo., is 150 ft; the runner-up, crossing the Missouri river in Montana, spans 126 ft. An entire span can often be assembled on the ground and erected after welding.

Two of the winners of the RWMA 1950 prize contest were on the program of the Tuesday morning resistance-welding session. These were J. W. Kehoe, Westinghouse Electric Corp., who captured first prize of $750 with his paper on "A Practical Method for Obtaining Consistent Resistance Welds" and I. S. Goodman, also of Westinghouse, who took third prize with a paper entitled, "Variables in Cross-Wire Welding of Dissimilar Metals." Other papers on the program were by J. H. Cooper, of The Taylor-Winfield Corp., and by a research trio from Rensselaer Polytechnic Institute: E. F. Nippes, J. M. Gerken and J. G. Maciora.

Mr. Kehoe's paper was of particular value. He distributed among the audience copies of a chart developed for a specific welder and explained how each listener could use its prin-

CHICAGO PLANNING COMMISSION: All members of this sextet worked hard to make the convention a success. Left to right are: L. C. Monroe, William Pearson, Jack Roscoe, A. F. Chouinard, L. S. McPhee and Ed Auler

ciples to develop similar charts to serve in his own plant. Kehoe's nine point procedure for production resistance welding applies to spot, seam and projection welding.

The Rensselaer group paper, presented by J. M. Gerken, covered a rather neat piece of research on the projection welding of thin steel. The shape of the projection, it was found, is as important as any other factor. Gerken and his cohorts have worked out an elliptical shape of projection that seems to do a good job.

Design Luncheon

It's regrettable that only 75 people saw fit to show up for the special design luncheon at Tuesday noon. The ones who stayed away missed not only an excellent luncheon but a heart-warming inspirational talk by George F. Nordenholt, editor of *Product Engineering*. Nordenholt threw away the title allotted to him, "Design for Production Economics," and built his talk about the theme, "Plan Not Little Things." The basic philosophy of the men who do the big things, he said, is that it is fatal to resist a new idea. He divided humanity into three states of mind when faced with a new idea: those whose reaction is negative, those where it is zero and those who have a positive reaction. The zero attitude is the all-too-common one except at the highest levels of research men and scientists, who have the intellectual power to question and revaluate previously conceived assumptions.

Designers who ignore welding, Mr. Nordenholt concluded, are not planning big things.

After this assisted take-off, the afternoon design session continued on its own power. If it wasn't the best of the convention's 24 technical sessions, it would be hard to name a better one. And it would be equally hard to choose between the merits of the papers presented by T. J. Crawford, Kenneth Jackson and R. H. Bennewitz on (respectively) the organization for design for production economy, the economies accomplished by redesign for welding and the applications of welded design for cost reduction.

Tom Crawford's paper was enhanced by its author's showmanship. He illustrated his talk with drawings thrown on a screen by means of a new "Vu-Graph" projector employing a periscope arrangement of mirrors to reflect the image of an illustration laid under a viewing tube on a horizontal surface. Mr. Crawford could work on his drawings with a special pencil while he talked and he could also add transparent overlays in a second color to show the effects of changes, revised designs and so on. Most of his illustrations were drawn from resistance welding, a field to which he has made notable contributions.

At the afternoon ship structure session, the talk of G. S. Mikhalapov was well received despite an unfortunate accident to the slide projector. Mikhalapov, who is connected with the Metallurgical Research and Development Co., Inc., had to improvise his illustrations on the blackboard. His subject was the notch sensitivity of welded ship plate by explosion test, a method of testing devised by him and explained in full in a paper presented at last year's convention. The explosion test, declared author Mikhalapov, duplicates the shock condition in ship steel more accurately than other testing methods since the explosion produces a shock wave in the steel comparable to that given by heavy seas.

John Vasta, Bureau of Ships, Navy Department, described the test set-up for the sixth large welded steel box girder to be tested by the Bureau of Ships. The previous five girders have been discussed in AWS meetings during the past two years. This girder showed unusual properties, the most outstanding being that the entire bottom section was in tension both longitudinally and laterally.

Wednesday Morning

Professor Robert S. Green, Ohio State University, deserves most of the credit for conceiving the special educational symposium presented on Wednesday morning. Green also acted as chairman and moderator, assisted by co-chairman M. L. Begeman, of the University of Texas. The subject of the symposium was: the need of professional training for the welding engineer. The employer point of view was presented by A. G. Bissell, Bureau of Ships, Navy Department; J. Heuschkel, Westinghouse Electric Corp.; J. J. Chyle, A. O. Smith Corp. and Dr. J. M. Parks, welding research, Armour Research Foundation. The college point of view was taken by Dr. G. E. Doan, professor of metallurgy at Lehigh University, Lehigh, Pa.; R. A. Wyant, assistant professor, department of metallurgy, Rensselaer Polytechnic Institute, and Gilbert S. Schaller, professor of mechanical engineering, University of Washington.

The general level of this meeting was high; there was much discussion, and it proved very interesting. While the speakers were in accord on the need for technical education in the fundamentals of metallurgy, the question of specialized welding courses was more or less left up in the air.

Professor Schaller also gave a paper at the simultaneous morning session on research, thus proving that you *can* occupy two different spaces at the same time if you are sufficient-

ly energetic. His paper on the development of a rotating electrode for manual metal-arc welding was one of the most original at the entire convention and deserves a rather more detailed description than we have been able to give to the other.

Schaller found that beginners in the university's course in arc welding were continually annoyed by frozen electrodes when they struck or tried to maintain an arc. This made learning to weld difficult, in some few cases even impossible. Schaller reasoned that what makes an electrode freeze is lack of motion; therefore it could not freeze if it is kept in continuous motion. Since the novice lacks the skill to do this, the problem was to devise a mechanical "whip" to do it for him.

Schaller mounted a 6-volt, 1/12-hp d-c motor on an electrode holder and used a worm gear and pinion arrangement to drive the electrode. The motor had two speeds: 110 and 69 rpm, of which the second gave the best results. Current is carried by the copper assembly that houses the gearing and is transmitted to the electrode by means of carbon brushes. Schaller tested 1/4-in. electrodes only, E-6010 and E-6013 types.

After an hour's time with this special equipment, Schaller found that the student could be graduated to the conventional electrode holder and would not experience the usual beginner's difficulties. More interesting, however, was the discovery that welds made with the rotating electrode do not require the same amount of welding current and hence lighter-gage sheet metal can be arc welded without burning through.

A jointly authored paper by M. L. Begeman, B. H. Amstead and U. J. Mashruwalla, department of mechanical engineering, University of Texas, revealed that there is little advantage in welding mild-steel plates in an evacuated chamber. On the contrary, spatter loss increases as the air pressure goes down. Various pressures were tried, down to 5-in. mercury absolute.

O. O. Miller, F. C. Kristofek and R. H. Aborn contributed another joint paper on the development of an isothermal or I. T. diagram for weld metal in manganese-molybdenum steel. The steel weld metal studied in this investigation contains 0.1% carbon, 1.6% manganese and 0.4% molybdenum. After the isothermal transformation diagram of the weld metal had been determined, it was used to derive a cooling transformation diagram. Miller, who presented the paper, is now with the International Nickel Co. at Bayonne, N. J., but the other authors are at the United States Steel Corp. research laboratories, Kearny, N. J.

The third Wednesday morning session covered technical problems encountered in the welding of structural steel. Four papers were scheduled on the program, but only three of them were given, the fourth paper having been withdrawn at the last minute.

Wednesday Afternoon

The trouble with the Wednesday afternoon schedule was that it just wasn't possible to take in both the very worthwhile session on machine welding and the stimulating discussion on controls and standards. One or the other had to be sacrificed.

The highlight of the automatic welding session was probably the paper by E. L. Frost and A. R. Lytle, Union Carbide and Carbon Research Laboratories, Inc., on submerged-arc welding with two electrodes in series. Lytle, who gave this paper, described a new automatic technique in which two electrodes are connected in series electrically while the work is insulated from the welding surface. The result is a fanlike arc that streams outward and results in a wide, thin weld deposit. Because of the lack of penetration, there is comparatively little dilution of the weld metal; dilution values less than 10% have been produced consistently and some values as low as 1.5% have been attained. The equipment offers many advantages for surface cladding—to put stainless on mild steel or perhaps to lay a deposit of pure copper over a steel base plate. With copper, however, the base metal must be preheated or the copper layer will not adhere.

The other papers at the session were on automatic welding in steel-mill maintenance, by W. P. Hoffman, International Harvester Co., Wisconsin Steel Works, and on jigs and fixtures for inert-arc welding by H. A. Huff, Jr., and A. N. Kugler, of Air Reduction Sales Co.

Chief attraction at the controls and standards session was the talk by J. F. Lincoln, president of The Lincoln Electric Co. Lincoln began with the contention that arc welding is a fully proved success, as is evidenced by the many billions of successful welds made in all kinds of structures. Welding standards, however, are creating unnecessary confusion and should be simplified by the elimination of unessential testing. "Present standards," he asserted, "are scaring the hell out of people who want to use welding. We in the American Welding Society have an obligation: either to justify the present welding standards or to simplify them to the point where they are as simple as they can be made."

Speaking at the same session, Lew Gilbert, editor of *Industry and Welding*, made the point that more educational work should be carried on among welding operators so that they would understand the engineering nature of what they are doing.

The third session of the afternoon was on the combined subject of machinery and maintenance. A good paper on machinery welding was read by E. J. Dewitt, one of three co-authors associated with Wallace Supplies Mfg. Co. DeWitt demonstrated his company's ingenuity in utilizing tubular sections for framing and for hydraulic oil storage.

Thursday Morning

One of the meatiest sessions of the convention was that on non-ferrous metals Thursday morning. Experts have long said that aluminum can't be welded by direct current in the inert-arc process, but John W. Mortimer, of Whitlock Mfg. Co., demonstrated that it can. The secret is to use today's extra-pure helium (99.9% pure, according to the Bureau of Mines) instead of argon shielding gas. The new helium gave good results with d-c straight-polarity inert-arc welding. Old helium (99.5% pure) wouldn't do the job, however. Another secret of the new d-c procedure is to hold the filler rod at an extremely low angle and move it away from the arc so that the filler metal melts a little in advance of the arc. A third trick, and a good one, is to use a new thoriated tungsten electrode. The end doesn't melt when subjected to arc temperatures, which means that the tungsten neither contaminates the work when accidentally touched nor is contaminated itself by

(Continued on page 41)

ELMER the weldor proved popular at the Welding Engineer's booth

MAIN ARENA of International Amphitheatre, showing a part of the 358 exhibits in the welding, metalworking and metal manufacturing industries

32nd Metal Show

"There's no business like show business" could well describe this biggest show of its kind.

FOR BENEFIT of those who could not attend, the Metal Show is still the longest "inspection tour" ever devised to develop aching feet and a healthy thirst. However, it's a serious business, which is probably why children were not admitted and women were not encouraged to attend.

Of the 358 exhibitors, no single group better exemplified the show theme of "High Production" than did the 39 exhibits devoted to welding and allied processes. For sheer interest, activity and visitor inquiries, the welding group easily walked away with top honors.

Chicago once again played host. The 32nd National Metal Congress and Exposition, to give it the long official title, was held at the International Amphitheater, Oct. 23-27. The five-day attendance total of 61,000 sets a new record for average attendance per day. In addition, an all-time high for a single day was established (18,600 on Wednesday).

ADVANCED TECHNIQUES SHOWN

In general, more efficient utilization of materials and manpower was stressed throughout as the only way to cope with impending or actual shortages. Advanced techniques were shown for dissimilar and hard-to-weld metals, for use of inert-gas shielding and for increased speeds of metal deposition in semiautomatic and automatic operations.

New products and equipment exhibited included set-ups for manual and machine inert-gas metal-arc welding, a twin-electrode submerged-arc welder, flame-cutting equipment, rectifier-type d-c arc welders, stud-welding power units, bench-mounted and floor-type spot welders, electrodes and electrode holders. A British stud-welding display drew favorable comment for the wide range of thicknesses the equipment could handle and its ability to weld similar and dissimilar metals without shielding (flux or inert gas).

Gleaming cutaway models of jet engines were featured in several exhibits to show utilization of the latest super-alloys and techniques for welding them. For non-destructive weld testing, there were offered cobalt-60 isotopes, ultrasonic and magnetic-particle inspection equipment.

"Elmer the weldor," on display at THE WELDING ENGINEER booth, proved to be one of the big drawing cards of the show. This metal man was made up of pipe and pipe fittings, welded together by W. C. Lilly and associates, Certified Pipe Welding Laboratory, Chicago.

The ASM Metallographic Exhibit and the Economy Theater were again stand-by features. The theater presented sound movies demonstrating steelmaking operations as well as many cost-saving welding techniques.

NAVY TEAR TEST EXHIBITED

Exhibits of the Naval Engineering Experiment Station, Annapolis, included examples of work done at the station in developing welding procedures and test methods. The popular "Welding I-Q" quiz box was back again with the old bell and buzzer hooked up to a brand-new set of 40 questions. A new feature was the Navy's Tear Test, developed at the New York Naval Shipyard. Its purpose is to determine and eliminate the susceptibility of ship plates to failure in service.

Visitors weren't bribed to come to this show, but there were some valuable prizes given away, among them a handsome hunting rifle and five small utility arc welders (one every day).

To sum it all up, the 32nd Metal Show was a good live number. Detroit will have to go some next year to beat it and its good weather.

250 kv, 36-in. F.D., 3-minute exposure

400 kv, 36-in. F.D., 2½-minute exposure

1,000 kv, 10-ft F.D., 2-minute exposure

2,000 kv, 30-ft F.D., 4½-minute exposure

Cobalt-60 (489) ¼ by ⅛ in., 36-in. F.D., 3-hr exp.

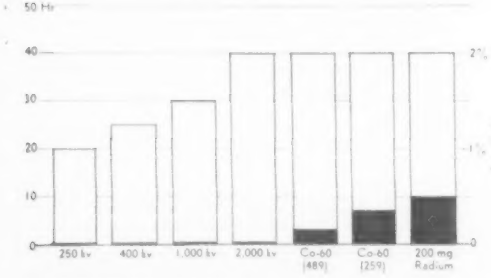
Cobalt-60 (259) ⅛ by ⅛ in., 36-in. F.D., 7-hr exp.

200 mg of radium, 36-in. F.D., 10¼-hr exposure

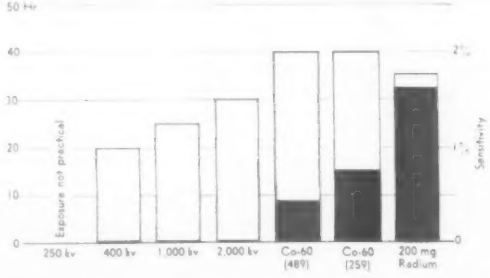
1—1-INCH TEST PLATE: radiographs taken of weld containing discontinuities at 1-in. thickness. Radiograph taken at 250 kv plainly shows outline and holes of the 1/2-in. (0.5) penetrameter representing 1% sensitivity

BY W. L. SCHWINN
Engineer, X-Ray Department, The Babcock & Wilcox Co.

Cobalt-60 Used



2—EXPOSURE TIME (black area) and sensitivity for radiographs of Fig. 1. A single dark line represents exposure of less than 15 minutes (all X-ray sources)



3—CHART of exposures of radiographs of Fig. 3, made in 2-in. plate. Cobalt-60 has registered a substantial time gain over the 200-mg capsule of radium

Pilot plate (200 kv)

400 kv, 5.0 MA, 15-minute exposure

1,000 kv, 2.8 MA, 25-second exposure

2,000 kv, 0.1 MA, 35-second exposure

Cobalt-60 (489) 1/4 by 1/8 in., 9-hr exposure

Cobalt-60 (259) 1/8 by 1/8 in., 15-hr exposure

200 mg of radium, 32-hr exposure

3—2-INCH TEST PLATE: Outline of 1.0 penetrameter representing 1% sensitivity can be seen on 400-kv X-ray radiograph. With all sources of radiation, 2% level of sensitivity is more readily discernible than in Fig. 1.

for Weld Inspection*

Will it pay to use any of the new radioactive isotopes for weld inspection? Babcock & Wilcox Co. made an extensive study to find out. Compared above are radiographs made with X-ray machines from 250,000 to 2,000,000 volts, radium and two specimens of cobalt-60 isotope.

SOME of the new radioactive isotopes would appear to offer interesting possibilities for the inspection of steel weldments. One of these is cobalt-60.

When selecting a method or tool for the radiographic inspection of weldments, it is best to give more consideration to the quality of the inspection than to the monetary cost of the equipment and its operation. Naturally the cost must be kept to a reasonable minimum figure, but the expenditures for inspection must result in a form of insurance against failure in service. We at Babcock & Wilcox like to look at radiographic inspection in this way.

To select the proper type of radio-

**Abstract of a paper presented during the annual meeting of the American Society for Testing Materials. For the complete paper, reference should be made to the "Symposium on the Role of Nondestructive Testing in the Economics of Production," published by the ASTM.*

graphic equipment, it is necessary to investigate each type of radiation to determine: (1) the best sensitivity possible under the given conditions and (2) the exposure time required.

The results of such an investigation involving cobalt-60 as a source of gamma radiation, in comparison with radium and X-rays, are the basis for this article.

There is, unfortunately, not sufficient space to review the earlier work done at the Babcock & Wilcox Co. to establish proper techniques and to qualify types of equipment. We had developed the techniques that would produce good sensitivity using 1,000,000-volt X-rays, 2,000,000-volt X-rays and radium. Since the radiation coming from cobalt-60 is in the range of 1.1 to 1.3 megavolts, we assumed that the technique required would be one between that used for the one-million and the two-million volt X-ray machines.

The results of this earlier work prompted us to continue investigations along these lines, studying the sources of radiation differing from those already investigated such as the cobalt-60 radioactive isotope.

Two pieces of cobalt-60 were delivered to the Barberton, O., plant of the Babcock & Wilcox Co. from the Oak Ridge National Laboratory. One of them was $\frac{1}{8}$ in. in diameter by $\frac{1}{8}$ in. long, and the other $\frac{1}{8}$ in. in diameter by $\frac{1}{4}$ in. long. Each piece had been goldplated to eliminate oxidation and the consequent loss of radioactive particles.

These isotopes samples were removed from the 200-lb lead shipping container with tongs and placed in pear-shaped aluminum capsules, which were in turn placed in lead carrying boxes. The pear-shaped capsules are made in two parts, one screwing into the other. Each half has an eyelet through which strings are tied. A capsule can thus be handled without coming nearer to the source of radiation than six feet. We checked the entire operation closely with radiation detection equipment, and the largest amount of radiation received by any of the personnel was 0.05r.*

To calculate exposure times satisfactorily, we first had to compare the intensities of the two isotopes with a 200-mg radium capsule. The strength of radium sources for radiographic purposes is given in milligrams of radium. However, the milligrams of cobalt-60 do not measure the strength of the source since the activity per milligram is not a natural constant as it is for radium but is dependent upon the time and intensity of neutron irradiation. A unit of radiation intensity, such as the milliroentgens per hour at one meter, is difficult to measure in any absolute sense for penetrating gamma radiations. It can, however, be measured closely enough to establish a practical basis for calculating exposure times in the radiography of steel. This method of calculation of exposures was used for this work.

Compared with Radium

The preliminary calculations, as made with ionization chambers and expressed in terms of milliroentgens (mr) per hr at a distance of 1 meter, were:

Cobalt-60, $\frac{1}{8}$ by $\frac{1}{4}$ = 480 mr per hr
Cobalt-60, $\frac{1}{8}$ by $\frac{1}{8}$ = 250 mr per hr
200-mg of radium = 120 mr per hr

Next we devised a means for identifying the isotopes by intensities and the year in which they were activated rather than by their physical sizes. Size could be misleading and meaningless in the event that similar physical-sized isotopes were received at future dates. The method we decided upon would always be accurate within a few percentage points. To all intents and purposes, the last digit of the measured intensity would always be zero. Hence we substituted for the zero the last digit of the year in which the isotope was activiated (assuming that all isotopes irradiated in that year emerged from the pile on the first day of July). Under this system, the largest isotope, a physical size of $\frac{1}{8}$ by $\frac{1}{4}$ in. and measuring 480 mr per hr at 1 meter, would be identified as cobalt-60 (489) $\frac{1}{8}$ by $\frac{1}{4}$ in.

If a person familiar with this method of identification hears someone speak of cobalt-60 (489), he knows immediately that the isotope was irradiated in 1949 (or ten years later in 1959) and had for all practical purposes emerged from the atomic pile on July 1 of that year. This information is close enough for all exposure calculations in the radiography of steel. There will be no confusion between the years 1949 and 1959 because the half life of cobalt-60 is 5.3 years; no overlap will be possible.

Inspection Technique

For our experimental work, we used a piece of steel plate 2 in. thick containing drilled holes to represent artificial defects. There were three rows of eight holes each. The first row represented defects 2% of the plate thickness. Of the eight holes in the second row, the first two represented 2% of the plate thickness, the second two 1.5%, the third two 1% and the last two 3%. The eight holes in the third row all represented 1.5%.

Radiographs were made comparing radium with both of the cobalt isotopes, first without a lead filter and then with a lead filter. An 0.080-in. lead filter was used at the film. We selected this thickness because of previous experimental work with 1,000,000-volt and 2,000,000-volt X-ray sources using lead filters of different thicknesses and at different locations (next to the source and at the film). We assumed that a technique comparable to anything established with 1,000,000-volt X-rays would be an advantage in the use of cobalt-60. Other selected factors were: 0.005-in. lead foil screens, Type "A" film and a focal distance of 36 inches. Penetrameters representing 1% and 2% of the plate thickness were placed on the source side of the plate.

The results of this work proved that a filter is a definite benefit; we used it throughout the balance of the investigation.

In addition to radium, cobalt-60 was also compared with X-rays of varying wave lengths. For this group of experimental exposures, we employed the same plate and the above-described technique. The X-rays were from sources of 100-kv, 1,000-kv, and 2,000-kv. Two additional exposures were made to determine the advantages or disadvantages, if any, of the calcium-tungstate screens. The 0.005-in. lead screens proved much more satisfactory than the Type "H" tungstate screens, although the "H" screens could be of some use in the examination of castings, etc., where large discontinuities or just major

* "r" is the abbreviation of roentgen, the international unit of quantity of X-rays. It should be compared with the curie, a unit of mass of radium emanation. The curie is the amount of any radioactive substance that emits the same number of alpha rays per unit of time as one gram of radium. Curie and roentgen are related quantitatively by the equation, 1 curie = 840r. The Editors.

imperfections are objectionable. It is possible to see 2% sensitivity in all the radiographs in this group. The 400-kv X-rays in this plate thickness appear to be superior to any other radiation sources.

To compare sensitivity of cobalt-60 with other types of radiation, we used a test plate containing several kinds of weld defects. This test plate was built up (as in previous work) to various thicknesses by adding plates from 1 to 4 in. in steps of 1 in. We radiographed the plate at each thickness with the various available sources of radiation with a technique of: 0.080-in. lead filter at the film, 0.005-in. lead foil front and back screens, Type "A" film and a 36-in. focal distance. We believed the results would furnish us enough information to prepare a chart showing the relative sensitivies and exposure times for these different sources of radiation

Sensitivity and Exposure Time

The radiographs taken of the test plate at 1 in. thick are shown in Fig. 1. These seven radiographs used as sources: 250-kv, 400-kv, 1,000-kv and 2,000-kv X-ray machines; the two samples of cobalt-60; 200 mg of radium. A comparison of the sensitivies shown indicates that the 250- and 400-kv X-ray machines do the outstanding job, followed by the 1,000,000-volt, then the 2,000,000-volt machine. Radium took fourth place and cobalt-60 placed fifth. Note the variation in the images of the fine cracks, best in the X-ograph taken at 250-kv and becoming less detailed in the radiographs taken with the shorter-wave-length X-rays and gamma radiation from radium and cobalt-60. It is apparent that neither radium nor radioactive isotope does the type of quality job in this plate thickness range obtained from X-rays. Radium, however, has a slight edge on cobalt-60; perhaps its low-energy components, which cobalt does not have, may account for the better contrast. In this thickness and technique, there is no advantage to be gained from a sensitivity standpoint in the use of cobalt-60 as a radiation source. However, when cobalt is considered from the standpoint of exposure time (Fig. 2), it does have an advantage over radium because of the higher intensity available at the same or smaller source size. X-ray exposure time at this thickness is practically negligible when compared to gamma-ray exposure.

How Do Inspection Costs Compare?

Cobalt-60

Cobalt-60 costs $50 per curie.
Effective half life is 5.3 years, less 20% per year.
Deterioration equals the cost per curie per year....$14.04

Radium

Radium costs $20 per mg to purchase or $2.50 per mg per year to rent.
1 curie of cobalt-60 equals approximately 1,400 mg of radium.

Rental cost of 1,400 mg of radium per curie per year $3,500*

Having a half life of 1,590 years, radium is practically inexpendable. Its purchase cost, therefore, could be based on an indefinite period of time. Written off in ten and in 50 years, the purchase costs per curie per year are: 10 years..$2,800
50 years.. 560

1,000,000-Volt X-Ray

Machine costs $50,000* or $5,000 per year.
Tube costs $5,000 per year.
Total cost per year equals $10,000.
Produces 55r per min at 1 meter or 3,300r per hr or 3,300,000r per 1,000 hr.
3,300,000r ÷ 840r per curie equals 3,928 curies equiv. radiation.
$10,000 annual cost ÷ 3,928 equals cost per curie per year $2.55

2,000,000-Volt X-Ray

Machine costs $100,000* or $10,000 per year.
Tube costs $10,000 per year.
Total cost per year equals $20,000.
Produces 208r per min at 1 meter, 1,248r per hr or 12,480,000r per 1,000 hr.
12,480,000r ÷ 840r per curie equals 14,857 curies equiv. radiation.
$20,000 annual cost ÷ 14,857 equals cost per curie per year $1.35

*These costs do not include the required shielding.

Results on 2-in. Plate

Radiographs taken with the plate built up to 2-in. thickness are shown in Fig. 3. Here it is quite easy to show both the outline of the penetrameters and the holes in the 2% penetrameter. While we are getting 2% sensitivity and better, it is apparent that we are losing the images of some of the fine cracks, even in the radiograph taken with X-rays at 400 kv. At this plate thickness, cobalt-60 is now on par with radium so far as sensitivity is concerned. And when we compare exposure times (Fig. 4), there is a substantial gain by the use of cobalt over the 200-mg capsule. X-ray time, again, is negligible as compared to either of the cobalt samples or to radium.

We also made (not shown) radiographs representing 3-in. plate thickness. These indicate that it is quite easy to show 1% sensitivity with all five sources of radiation, when judging the radiographs by penetrameters. Insofar as fine cracks are concerned, however, practically all traces of the image of the fine crack is lost except possibly that of the largest and most intense crack. This latter image was still partially visible in the radiograph taken with X-rays at 2,000 kv. There is not enough difference in the sensitivity shown between cobalt-60, radium and 1,000-kv X-rays to warrant discussion. When the radiographs are considered from an exposure angle, an impractical exposure time is approached with this amount of radium and this technique. The small cobalt-60 isotope is still within a very practical range, however.

At 4-in. thickness, we again obtained a 1% sensitivity with all sources of radiation used. Perhaps ¾% sensitivity was discernible in

the 1,000,000-volt and 2,000,000-volt radiographs; however, in all of the 4-in. radiographs the cracks showing in the pilot plate have been lost. The difference in sensitivity between the various radiation sources was found negligible. Considering this group from an exposure angle, the time for radium has increased to an impractical amount, the small isotope is verging on the impractical but the large isotope could possibly be used to radiograph another inch in thickness before it too would reach an impractical exposure time.

We decided to re-examine the 1-in. plate using Type "M" film to see what improved sensitivity could be obtained with the various sources of radiation under consideration. Only the radium and isotope sources were tested since it had previously been shown that 1% sensitivity was obtainable using the proper X-ray technique. With this film, we demonstrated that 1% sensitivity is obtainable using either the cobalt or radium source; the radium, however, requires a very long exposure as compared to the large isotope. The point may be one worth considering when plate of lighter thickness is to be gamma-ray inspected.

We also made an investigation of the secondary radiation characteristics by means of an exposure of an irregularly shaped object without any blocking or filter. For this purpose, we selected a cast steel cone-shaped piercing point varying in thickness from 1 to 2¾ in. From the radiographs, it was apparent that cobalt-60 did everything that radium or the 2,000-kv X-ray unit could do, both in sensitivity and in latitude.

Cost Comparisons

To compare the cost of cobalt-60 to other sources of radiation, it is necessary to find the cost per curie per year for equivalent amounts of radiation. We assumed that 1,000 hours operation or radiation would be normal for a year. Since an X-ray tube is expected to give 1,000 hours' life, X-ray costs would include a new tube every year in addition to the original cost of the equipment. We also figured on equipment costs being written off in a period of ten years. Upon this basis, we arrive at the comparison tabulated at the top of page 27.

Figured on the basis of costs per curie per year, the various sources compare as:

Cobalt-60	$14.04
Radium rental	$3,500
Radium purchase	
(10 years)	$2,800
(50 years)	$560
1,000-kv X-ray	$2.55
2,000-kv X-ray	$1.35

From the cost breakdown listed above, it is evident that cobalt-60 is not a substitute for X-ray equipment.

The total elapsed time necessary to radiograph a job is another important factor which must be considered when making any comparison. For example, a complete girth seam on a 72-in. OD vessel, 4 in. thick, could be radiographed with an isotope of 430 mr per hr at 1 meter intensity, using double-loaded Type "A" films, in approximately 40 hours. With a 2,000,000-volt X-ray machine, the seam could be radiographed in 20 exposures at 2 minutes per exposure, a total exposure time of 40 minutes. The time required to position the films, focus the tube, etc., would be comparable to the time necessary to encase the circumferential seam with films and to remove them after the exposure was completed in the case of cobalt-60. While the initial outlay of money for X-ray equipment is higher, it is still cheaper, faster and results in a better-quality radiograph. In the case of longitudinal seams of any appreciable length, the X-ray, of course, would be much more feasible.

When comparing cobalt-60 with radium, altogether different factors are important. Cobalt-60 is much cheaper per unit cost per curie, and shorter exposure times are possible due to the higher intensities at a smaller source size.

"Remember! Double time for this!"

The technique to be used with cobalt-60 depends upon the type of job to be radiographed and the type of discontinuity that is to be disclosed. Generally, 0.005-in. lead screens using 0.030-in. lead filter at the film and Type "A" film will be satisfactory; however (as pointed out), the same technique using Type "M" film will give better sensitivity, especially in the lower plate thickness ranges. Another very satisfactory technique, which this survey did not cover, is the use of double-film-loaded cassettes. This method employs a front screen 0.005 in. thick, a single film, a piece of 0.005-in. lead, a single film and a back screen about 0.005 to 0.030 in. thick. With this technique, it is not necessary to use the 0.030-in. front filter because the contrast is built up when the films are superimposed for viewing. For reproduction reasons, no exhibits of this method were included.

With the proper technique, it is possible to obtain 1% sensitivity in all plate ranges from 1 to 4 in. The exposure times required as compared to similar physical sized radium sources are much shorter.

It Rates a Place

In view of the findings outlined in this article, we believe that cobalt-60 is worthy of a place as a radiation source for some applications in the radiographic inspection of steel weldments. It is a portable radiation source good for short film distances because of its small size and high intensity. Its small source size and high intensity make cobalt-60 better than radium for exposures of objects having high subject contrast. It is superior to radium where fine radiographic detail is required. Its use with fine grain film gives adequate sensitivity over a wide range of material thickness.

From the cost point of view, cobalt-60 requires a very much smaller investment than radium. Even when radium is purchased over a long period, say 50 years, it would not equal the low cost of cobalt-60. On the basis of curies per year, the high-voltage X-ray equipment appears to be the most economical despite the high shielding costs that are required for its safe operation.

NEWLY ELECTED officers; left to right: Noah A. Kahn, vice-president; W. E. Thomas, president; Dr. Robert C. McMaster, treasurer, and Philip D. Johnson, secretary

PAST PRESIDENTS confer with Mehl lecturer McMaster. Left to right are: Al F. Cota, of A. O. Smith Corp.; Dr. Leslie S. Ball, Naval Ordnance Laboratory; Dr. R. C. McMaster; Dr. Carleton G. Lutts, Boston Navy Yard; Dr. Kent Van Horn, Alum. Co of America

10th Annual Meeting of SNDT

BY JACK MEDOFF

THREE valuable symposiums featured the 1950 annual meeting of the Society for Non-Destructive Testing, Hotel Morrison, Chicago, Oct. 24-26. These were on the timely subjects: (1) magnetic-particle inspection; (2) radio-isotopes and (3) ultrasonics. In addition, Dr. Robert C. McMaster, Battelle Memorial Institute, delivered the annual Mehl lecture, featuring each year an outstanding contributor from industry to the science of non-destructive testing.

This meeting was the most successful and the best attended in the Society's history. Nor was the attendance confined to members from the U. S.—there was representation from Canada, Japan and the Netherlands.

Pipe welding was discussed in an excellent paper (to be published in THE WELDING ENGINEER) titled, "Magnetic-Particle Inspection of Welded Piping and Tubing," by Messrs. J. E. Clarke, R. A. Peterson and T. Dunsheath, of the Magnaflux Corp., Chicago. It described the continuous inspection that has been integrated with the manufacture of electric resistance-welded pipe.

"Industrial applications of Radio-Isotopes," by Dr. Paul C. Aebersold, chief Isotopes Division, AEC, Oak Ridge, Tenn., presented additional useful information to that developed in the "Symposium on Radio-Isotopes" by Dr. Gerold H. Tenney, Arthur I. Bernard and Thomas N. White, of Los Alamos Scientific Laboratory, and Dr. Adair Morrison, head of industrial radiology section, National Research Council, Ottawa, Canada.

"Management's View of Non-Destructive Testing" by John P. Magos, director of research and engineering, Crane Co., Chicago, concluded with the thought that, "Management welcomes non-destructive testing . . . to minimize inspection costs and maximize results . . . and it should be incorporated into all companies' quality control programs."

The aircraft industry was strongly represented among the audience and the speakers. The subjects covered a wide range, including industrial and radiographic standards for aluminum and magnesium castings.

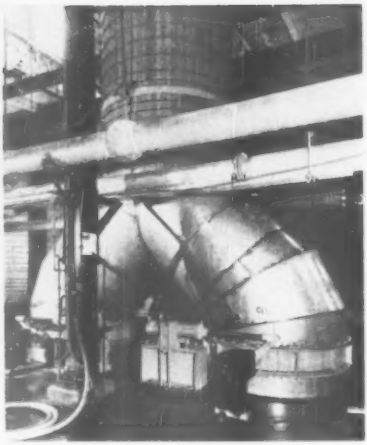
An interesting new method of high-frequency vibration testing, bridging the gap between non-destructive and proof testing, was presented by Dr. Robert Rawlins, head of the transonic research department, Lockheed Aircraft Corp.

"Sonoscopy" was proposed by Dr. Leslie W. Ball, chief of physics research department, Naval Ordnance Laboratory, to cover the same relationship to sound waves that fluoroscopy does to X-rays, in his talk on "Direct Visualization of Ultrasonic Images." H. E. Van Valkenburg, of Sperry Products Corp., described an acoustic device for this purpose in his story of much research for "Production of Ultrasonic Images."

This year's Mehl lecturer, Dr. Robert C. McMaster, supervisor electrical engineering division, Battelle Memorial Institute, presented "New Developments in Xeroradiography," a subject with which he has been very closely associated. Xeroradiography is a newly-developed, extremely rapid, dry-development method of obtaining permanent radiographic images with X-rays, radium or isotopes. No films or chemical processing are required, and the plates can be reused indefinitely.

As usual, Dr. McMaster gave a distinguished presentation in his typically flawless style, and he brought the technical program of the society's 10th annual meeting to a very successful conclusion.

1—SOUNDVIEW Pulp Co. plant at Everett, Wash., showing several of the welded stainless steel tee-fittings described in the text



2—Y-BRANCHES 6 ft in diameter rise from the vomit stacks of two digesters

ELC Stainless for

Here is a material that may save money on such equipment as that made for processing in the paper, chemical or other industry where corrosion is found.

BY GEORGE T. DEXTER

Vice-president, Puget Sound Sheet Metal Works, Seattle

WE AT Puget Sound Sheet Metal Works are rather proud of the variety of custom-made products we are continually turning out. We fabricate steel, stainless steel, aluminum, nickel, copper and other metals, including alloys and clads, in thicknesses up to 1 in. Our new plant, built in 1949, is designed expressly for custom fabrication. The ground area of seven acres includes 70,000 sq ft of shop floor space. Cranes of 30-ton capacity, on rails 42 ft above the floor, serve over 300 lineal ft of craneways 50 ft wide. Transfer tracks and monorails connect the various bays and buildings. Plant-wide systems distribute electric power, compressed air and welding gases.

We Cut, Form and Weld

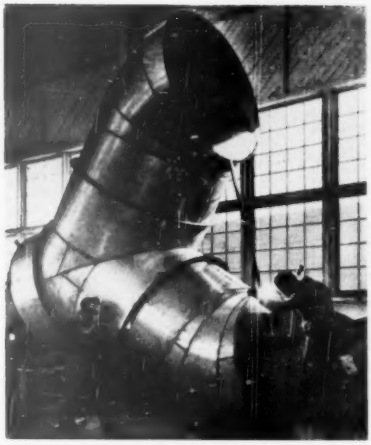
For cutting and forming, our equipment includes a power brake 16 ft long (able to exert pressures up to 300 tons), plate shears 12 ft long, a plate-flanging machine that takes up to ½-in. steel, oxyacetylene cutting machines, metal-cutting band saws, abrasive cut-off saws and friction saws. The friction saw, a comparatively recent development, leaves an exceptionally clean edge; it melts rather than cuts its way through the plate.

Our welders are qualified under ASME and API codes and are familiar with the many special methods required to weld nickel, copper, aluminum, clad steel, stainless, Monel, Inconel, silicon-bronze and other alloys. Puget Sound Sheet Metal is well equipped for gas-shielded arc welding, a process we find especially valuable in the welding of thin sheets of stainless steel, copper or aluminum. We use the most advanced type of submerged-arc automatic welding equipment—and mount it so that it can be easily adjusted for any job up to 16 ft in diameter by 54 ft long.

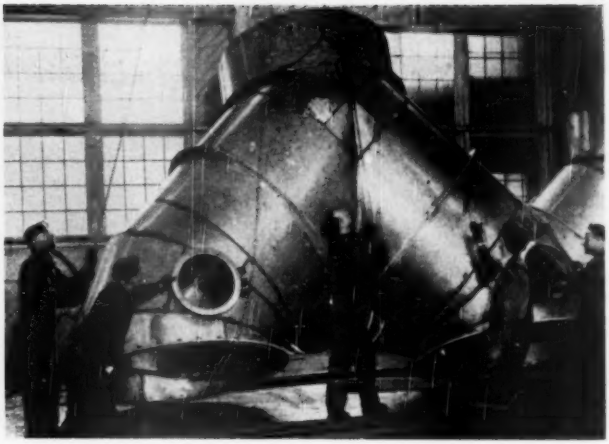
Sandblasting and spray painting are done in separate buildings, each approximately 20 by 60 ft. Four rail spurs enter the plant, three of them under craneways. We ship products out over all of the four transcontinental rail lines that serve Seattle and also by water to Alaska, Hawaii and the Orient.

Our customers represent many different industries. We have supplied pulp and paper mills with acid storage tanks, breechings, process tanks, stacks, hoppers, conveying equipment and fabricated pipe; brewers with malt bins, storage tanks, fermenters and other brewhouse equipment; chemical plants with agitators, condensers, evaporators, heat exchangers, jacketed vessels, tanks, stills and vacuum vessels; food processors with bolted tanks, brine tanks, chutes, condensers, cookers, steam hoods, storage tanks, hoppers, mixing tanks and processing tables; mines and mills with conveying equipment, cooling towers, dust chambers, steel flumes and ventilation piping; the petroleum industry with field-erected tanks, steel buildings, storage tanks, stairs and walkways and process equipment.

Though much could be written about any of these products, I believe that one of our most interesting jobs was the fabrication of special stainless-steel fittings for the Soundview Pulp Co., Everett, Wash., a



3—FABRICATING the 6-ft Y shown in Fig. 2 at Puget Sound Sheet Metal Works



4—BIG Y-fitting for the sulphur-steam recovery system is being lifted to position in which it will be installed in the pulp mill

Pulp Mill Duct System

manufacturer of bleached sulphite pulp for the paper industry. These fittings were mostly 6-ft in diameter and were made for a huge new sulphur dioxide recovery system for blowpit gases.

Made of ELC Steel

What puts the job out of the ordinary class, as far as the welding industry in general is concerned, is the material that went into these fittings. It was type 316 ELC (extra-low-carbon) stainless steel. Armco Steel Corp., Middletown, O., manufactures three of these extra-low-carbon steels: types 304 ELC, 316 ELC and 317 ELC, each having the same analysis as the alloy of the corresponding standard type number except for the carbon content. Whereas ordinary 304 and 316 stainless steels have 0.08 and 0.10% carbon, their ELC twins each has a maximum carbon content of only 0.03%. These steels aid in the elimination of intergranular corrosion by preventing carbide precipitation during welding. Columbium is not needed as a stabilizing element: the low carbon content accomplishes the same purpose. Nor is annealing of the finished weldment necessary, except where engineering requirements specify stress relief. This alone is a big benefit.

You can readily see the advantages of lower material cost and greater corrosion resistance adjacent to the welds. The ELC grades of stainless are naturals for any welded equipment exposed to corrosive conditions at service temperatures below the sensitizing range. They are not recommended, however, where service temperatures reach 800 F for extended periods. At lower temperatures than that, type 316 ELC and its sisters staunchly resist corrosive attack near the welds. Hence the equipment lasts longer, and there are fewer maintenance problems and interruptions to production.

This material is especially suitable for large assemblies, fabricated from heavy-gage sheets or plates. Annealing of such large objects as the 6-ft pipe fittings we fabricated for Soundview Pulp would be extremely costly if we had had to do it. Furthermore, annealing is not possible when field repairs are made on large fabricated structures.

Need Special Electrodes

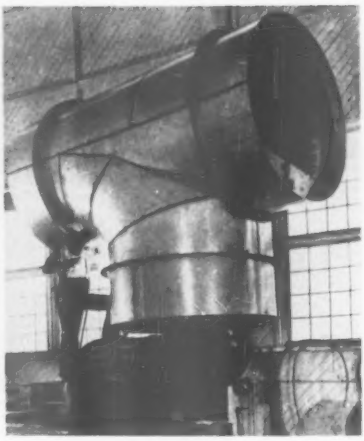
It is my impression that very little information concerning the welding of ELC steels has ever appeared in the trade press. For 304 ELC, the steel manufacturer suggests welding electrodes of 309 Cb or 310 Cb for root beads joining stainless to carbon steel and 308 ELC or 347 for cover beads or fillet beads where stainless is welded to stainless.

For 316 ELC, the recommendation is to use 310 Mo electrodes where stainless is welded to carbon steel and 316 ELC, 318 or 310 Mo electrodes where stainless is welded to stainless. For 317 ELC, 310 Mo electrodes will cover both applications. It is obvious from the above that 310 Mo electrodes are the most useful for a variety of applications and will probably give the best results under the most conditions. However, we did not use type 310 Mo on the Soundview Pulp job because we felt that the magnitude of the work justified the manufacture of special electrodes.

All our welding was done with 316 ELC electrodes, the same material as the parent metal. These were especially made for this particular job in diameters of 1/8 and 5/32 in. The bare wire was drawn by the Rustless Iron & Steel Div. of Armco Corp., and the coating was applied by the Reid-Avery Co., Baltimore.

Before I get down to the actual welding of the big fittings, it might be a good idea to tell why they were

5—PARTIALLY MADE 72-in. stainless steel tee. Weldor works on the 36-in. side outlet elbow that connects to the big tee fitting



6—TEE is being welded while mounted on a welding positioner. Note stiffeners

made. Pulp for the paper industry is made by subjecting wood to the action or "digestion" of sulphuric acid. The gases, notably sulphur dioxide, that escape from the digesters into the atmosphere were a constant source of irritation to the noses of people living near the mill. To eliminate the smell from the air and save operating expense by recovering sulphur and heat from the blowpit gases, the Soundview Pulp Co. developed its own sulphur dioxide recovery system.

Each of the twelve digesters in the mill has a blowpit equipped with a drainage bottom of perforated stainless-steel plates. When a digester is blown, a drain valve on the blowpit is closed. A hydraulic cylinder operates a butterfly valve in the gas outlet above each pit. When a digester is blown, the butterfly valve for its pit is open and the others are closed. The gases from the blowpit are taken through coolers, where they lose their heat to spiral-type heat exchangers, and are then carried in a 19-in., 16-gage duct of type 316 stainless to an 18-in. gas fan. The fan is driven at 1,800 rpm and operates continuously, handling about 7,000 cfm during the blow cycle. These details should be sufficient to suggest the operation.

Adjacent pits are joined by a Y-fitting 72 in. in diameter, fabricated of 10 and 12 gage 316 ELC stainless sheet. There is one Y to serve every two digesters; hence six of them had to be fabricated. We also made several 72 by 72 by 72 in. tees with 36-in. side outlet elbows and several 72-in. saddles for the vomit stacks. All of these fittings were entirely shop fabricated: we sent out the completed fittings as units and did no field welding.

Making the Y-Fittings

Figure 1, an exterior view of the Soundview plant, shows several of the welded stainless-steel tees and smaller diameter welded stainless piping. In Fig. 2 we see one of the Y-branches that conducts the blowpit gases from the digesters to the recovery system. The 6-ft butterfly valves are at the bottom of each leg of the Y.

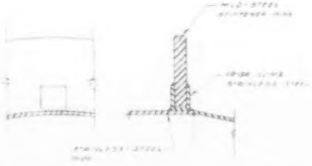
If you will look closely at Fig. 2, you will see that each leg of the Y is made by joining together four gores or courses. As these fittings were 72 in. in diameter, we used two sheets to each gore. We designed our shop fabrication to use mostly butt welding by the manual metal-arc process, reserving fillet welds for the comparatively few flanges that had to be welded.

How one of the big Y's looked when almost completed is shown in Fig. 3. In Fig. 4, it is being lifted to the position in which it will be installed in the pulp mill.

We were required to hold fairly close dimensional tolerances on all of these fittings and particularly on the Y's. First, we set up a jig to locate the three outlets. Then we tacked the various sections of the Y together to fit perfectly into the fixture. Finally, we joined the tacks to make the welds continuous and welded all seams from both sides. Except that the welding was somewhat slower than we normally encounter with type 316 stainless, we had no particular difficulty in welding the extra-low-carbon material.

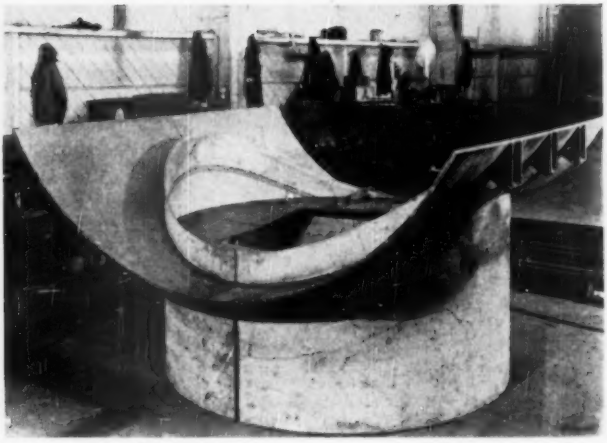
Putting on Stiffening Rings

Figure 5 shows a partially completed 72-in. tee (shown installed in Fig. 1). The weldor at the right of the picture is working on the 36-in. side outlet elbow that connects to the big fitting. To the outside of the tee were fastened ½ by 3 in. stiffener rings and to the outside of the elbow ⅜ by 2½ in. stiffener rings. The method we used to join these stiffener rings was rather novel. For reasons of economy, engineers of the Soundview Pulp Co. had specified that these rings be made of mild steel, and they did not wish to have this material welded directly to the stainless fittings. The accompanying sketch (Fig. 10) shows our solution.



10—METHOD of welding stiffening rings to body of pipe fitting

7—TURNED 90 deg from Fig. 6, tee is now welded horizontally on its underside



8—SADDLE for the digester vomit stack is another 72-in.-diam pipe fitting. Formed plate and gussets at right are of ½-in. plate

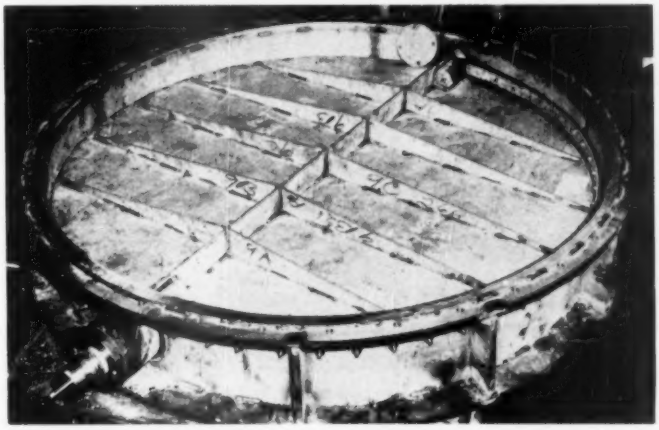
We simply made clips of 10-gage stainless steel and welded them to the body of the stainless fittings. The mild-steel rings were then inserted within and welded to these clips.

Because all these fittings were circular in shape, it wasn't necessary to take any particular precautions to guard against heat distortion. However, we did take a great deal of care in positioning our welds. We set up each of the big fittings on a conventional type of weld positioner and tried to do practically all welding in a downhand position. Fig. 6 shows one of the tees being welded while it is on the positioner. In Fig. 7, the tee has been turned 90 deg to permit welding on the underside to be done in the horizontal position.

Figure 8 shows a saddle for a vomit stack, another fitting for 72-in.-diameter piping. The saddle required a 14-gage liner to be made in sections and fitted to a ½-in. formed plate. Continuous welds were made on the liner and to join the liner to the 6-gage sleeve in order to prevent any leakage to the ½-in. plate. The gussets that may be seen at the right of the picture were also fabricated of ½-in. plate.

We didn't make the butterfly valves but, to give you good measure, one of them is pictured in Fig. 9. This 6-ft-diameter welded valve was made of type 316 ELC stainless-steel plates.

It is readily recognized that gases having a high sulphur content can have very great corrosive effects upon metal. The use of extra-low-carbon steel should help to minimize corrosion and make field repair simpler because of the fact that annealing is not required after welding.

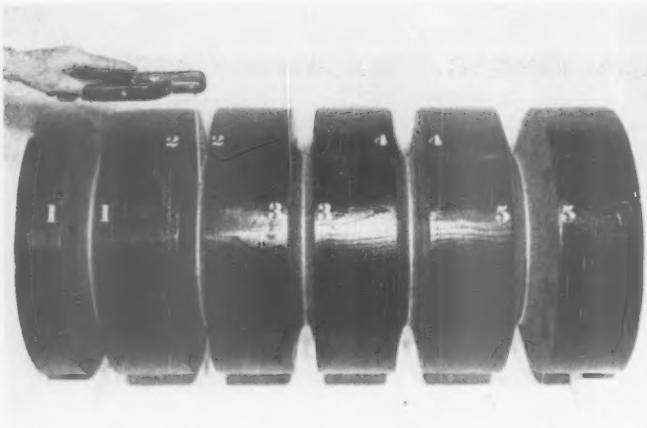


9—WELDED BUTTERFLY VALVES fit at the base of each leg of the Y shown in Fig. 2. This 6-ft hydraulically operated valve opens to the blowpit

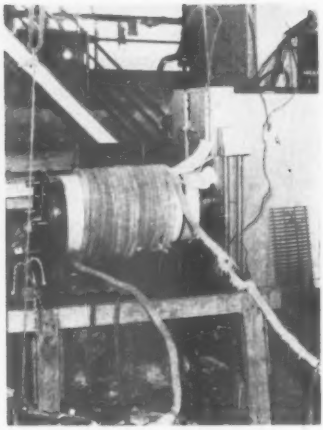
The reader may be interested in how the new sulphur and heat recovery system has worked out. According to R. Irwin Thieme, technical director of Soundview Pulp Co., average values show a recovery of about 40 lb of sulphur per air dry ton of bleached pulp produced.* That represents a sulphur recovery equivalent to 80% of the sulphur in the blowpit gases. Heat recovery is about 950 lb of steam per air dry ton of bleached sulphite pulp—about 76% of the total available heat. The net effect has been to reduce the sulphur burning and gas cooling requirements of the whole acid plant and thereby give it an increased capacity of about 15%.

Prior to the use of this system, workers in the blowpit room and digester building had to wear gas masks during a part of the time as a normal procedure. Now there is no leakage of gas into the working space. The public nuisance of discharging sulphurous gases into the atmosphere has also been ended.

*In a paper presented at a Pacific Coast Superintendents' convention.



1—WOODEN MOCK-UP used to study proposed weld grooves for tubing of 3⅜-in. wall thickness, 14-in. nominal diameter, 2¼% chrome and 1% moly



2—INDUCTION COIL for preheating and stress relieving pipe

Welding High-Temperature

New turbogenerators at a Commonwealth Edison Company station were designed for steam to enter turbines at a pressure of 1,800 psi and temperature of 1,050 F. The piping that could carry it had to be welded.

By E. C. BAILEY

Structural and Mechanical Div., Commonwealth Edison Co., Chicago

ELECTRICITY for Chicago and the northern section of the state of Illinois is produced and distributed by the Commonwealth Edison Co., Public Service Co. of Northern Illinois, Illinois Northern Utilities Co. and the Western United Gas and Electric Co. The generating stations of the four companies are interconnected and operated as a group. Generating units having capacities of 100,000 to 150,000 kw are used to take advantage of the saving in cost that may be obtained per installed kw of capacity.

Since the end of the war, 514,000 kw of capacity have been installed by the four companies, and an additional 260,000 kw of capacity will have been installed by the end of 1952. This total of 774,000 kw includes two 150,000-kw units at the Commonwealth Edison Company's new Ridgeland station west of Chicago, one of which is now in service and another scheduled for 1951.

These new generating units have been designed to use high-pressure, high-temperature steam. The rise in steam pressures and temperatures has been made possible by the development of creep-resistant alloy steels for piping, boiler and turbine parts.

These materials call for new methods of fabricating. Welding has been more responsible than any other fabrication process for the successful use of today's high pressures and temperatures. Without satisfactory field welding procedures, the entire program would have been seriously handicapped.

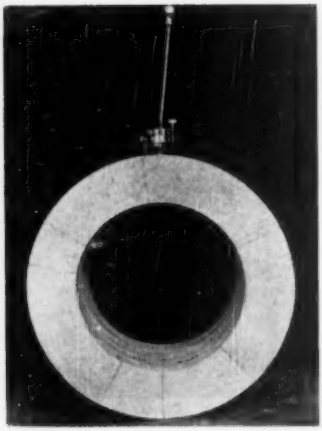
At Ridgeland station, the boilers will produce steam at 1,900 psi gage and 1,050 F; this steam will enter the turbines at 1,800 psi gage and 1,050 F. At Fisk, Northwest and Calumet stations, we have been successfully operating equipment using steam at 1,200 psi gage and 900 to 925 F. The heavy-wall alloy-steel pipe used in the three latter stations is light in weight compared to the high-pressure steam pipe we use at Ridgeland. Both the increase in pressure and the increase in temperature made it mandatory to increase the pipe wall thickness. Table I dramatically shows the differences between the pipes at the Fisk and Ridgeland stations (see page 37).

The high-pressure steam piping used at Fisk and Calumet stations was manufactured by piercing and rolling a steel billet to the desired size. The Ridgeland piping is too thick and its tolerances are too close for this type of manufacture on equipment now available. It had to be produced by forging and machining. First, a steel billet was forged to approximately the desired OD; it was then set up in a special lathe for boring of the inner surface and machining of the outer surface.

New Procedures Developed

Naturally, the heavier wall on this pipe, its higher alloy content and closer size tolerances necessitated more rigid inspection. New welding procedures were developed and tested; more power was used for stress-relieving equipment, and new equipment for gamma-ray inspection of completed welds was built and

3—TUBING SAMPLE (14-in. nominal diameter and 3⅜-in. wall thickness) is ready to receive the root pass. Note back-up ring under the root opening



4—JIG developed for positioning radium capsule for inspection

Piping

5—JIG AND FILM in position on 10-in. nominal diameter tubing having a 2½-in. wall. Gamma-ray photographs will show condition of finished weld

tried out. The erection contractor even had to use special sling saddles to avoid damaging the exterior machined surface of the pipe during unloading and erection as any scars would be potential stress concentration points.

The installations at Fisk and Northwest stations, made prior to the war, used carbon-moly high-pressure steam piping. Graphitization, it was found, develops adjacent to the welds when materials of this composition are subjected to high temperatures. On the units we installed after the war at Calumet and Fisk stations, a change was made to a steel of 1% chrome, ½% moly for the high-pressure steam piping. The higher temperature (1,050 F vs. 925 F) steam that will be used at Ridgeland made it necessary to use a steel of 2¼% chrome, 1% moly for the high-pressure steam piping.

Wall 3-in. Thick

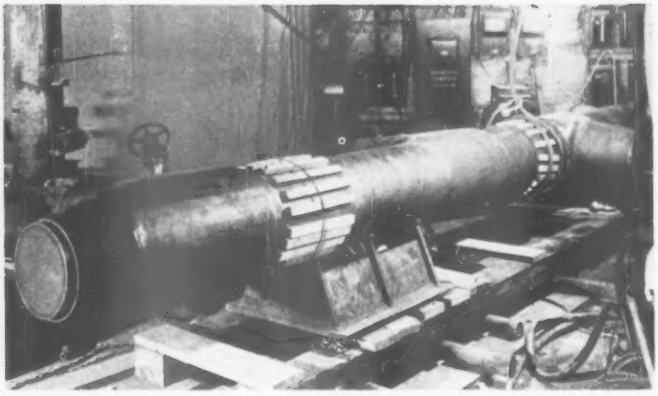
During the early design stages it became evident that a pipe wall thickness of at least 3 in. would be required if a pipe large enough in diameter to carry the quantities of steam needed were to be used between the boilers. Boiler manufacturers, piping fabricators and others were canvassed to determine the feasibility of using such heavy-walled tubing. As a result of this investigation, we felt that: (1) it would be possible to obtain forged-and-bored tubing of the desired composition, (2) that the tubing could be fabricated in shops located in the Chicago area and (3) that the welds could be made successfully both in the fabricating shops and in the field. It is the purpose of this article to tell how we developed a satisfactory welding procedure.

As a first step, we made a wooden mock-up of the 14 in. (nominal diameter) tubing. This mock-up (Fig. 1) incorporated five different weld grooves. The mock-up was given to the weldors to try out, and it was studied by the fabricators and designers. The weld groove finally chosen met the requirements of all three groups.

The selected groove incorporates a chromeplated back-up ring of the same material as the pipe. The back-up ring and the mating pipe ends have a 5-deg taper. The groove has a 3/16-in. root gap to provide room for a good clean root pass. The pipe terminates in a 1/16-in. wall at the root gap in preference to the sharp edge used by some manufacturers. This feature, we hoped, would prevent damage to the pipe ends and interference with the back-up ring fit during field erection.

The groove starts with a cutback on a 3/16-in. radius and advances

6—WELDING of main steam piping



7—SLING SADDLES protect pipes during their erection and handling

with a 20-deg vertical cutback tangent to the circular portion. At a point 1¾ in. out from the inner wall, the cutback changes from 20 to 10 deg with the vertical. Up to this point, the groove is identical with that previously used on schedule 160 tubing (both carbon-moly steel and 1%-chrome, ½%-moly steel), on which the weldors were already qualified.

This welding groove provides an opening 2⅛ in. wide at the outer surface of the 14-in. (nominal size) tubing and an opening 1⅞ in. wide at the outer surface of the 10-in. tubing. We estimated that 84 passes would be required on the 14-in. tubing and 54 passes on the 10-in. tubing when welds were made with the tubing in a fixed horizontal position. When welding with the tubing in a fixed vertical position, 145 passes would be required for the 14-in. and 99 passes for the 10-in. Here is how it worked out:

14-in. Tubing

Fixed horizontal . . . . . 76 passes
Fixed vertical . . . . . 225 passes

10-in. Tubing

Fixed horizontal . . . . . 35 passes
Fixed vertical . . . . . 128 passes

Rod consumption averaged 160 lb per joint in the 14-in. tubing and 75 lb of rods per joint in the 10-in. tubing. After trying out various types of electrodes, we finally decided upon a lime-coated rod that would give a weld deposit of the same composition as the base metal of the tubing. This rod is in accordance with ASTM specification A-316-48T Classification No. E-9015.

Test Stress Relieving

At this time, the fabricating contractor had two 14-in. (nominal diameter) 2¼% chrome, 1% moly cast pipe sections about 3 ft long ready for use in qualifying the welding procedure. We decided, however, to try out the stress-relieving equipment and techniques before making the first weld. The two sections were clamped together end-to-end, and a light single-pass weld was made at the outer circumference of the joint between the two squared ends. Numerous thermocouples were then installed at various quadrants, at varying depths in the metal and at various distances from the butted joint. Preheating and stress-relieving cycles were performed using gas heating rings, stranded copper wire induction coils (Fig. 2) and induction-heating coils of water-cooled copper tubing. The most uniform heat control with the least use of electricity was obtained with 27 turns of 500,000 circular mil stranded copper wire. The wire was jacketed with woven asbestos tubing and separated from the pipe by two layers of ⅛-in. asbestos paper. With this arrangement, the stress-relieving temperature of 1,350 F ± 25 F could be readily reached and maintained. Also, the cooling rate of 300 F per hour could be very closely controlled.

Gamma-Ray Inspection

Study of the welding records of other fabricators showed that most defects requiring repair occurred in the root passes (Fig. 3). We didn't want to have to dig down through 3⅜ in. of metal to find possible defects. It seemed logical, therefore, to inspect the first inch of welding by gamma rays before doing any more welding. After completion, we then reinspected the entire weld by gamma radiography. This inspection procedure increased the estimated elapsed time per weld considerably, but we felt the added cost would be well justified if any defects were found. In actual practice, the elapsed time required per weld breaks down as shown in Table II. Note that a total time of 228 hr per weld was required for the 14-in. pipe and 116 hr per weld for the 10-in. pipe.

We used ⅛-in. electrodes for the first four passes and 5/32-in. electrodes for the remainder of the weld. The welding machine was set to deliver 85-115 amp at 20-24 volts. This setting was for both the horizontal and vertical fixed positions when welding 14-in. or 10-in. nominal-diameter tubing using ⅛-in. electrodes. When 5/32-in. electrodes were used in the horizontal fixed position, the welding machine was set to deliver 120-165 amp at 23-26 volts; in the fixed vertical position, it was set for 120-170 amp at 23-26 volts. These settings gave good penetration and an arc that handles quite easily. The beads were applied with a slight weaving motion. We inspected numerous craters at the start and finish of individual beads but found no evidence of crater cracking.

While we were working out the

welding procedure and stress-relieving technique, development of gamma-ray equipment and techniques was also in progress. Two types of six-wheeled buggies were built to carry the radium capsule inside the pipe to the weld to eliminate openings in the pipe for inserting radium capsules. These buggies were inserted in the open end of the pipe and pulled up into position with cables attached at either end. The position of the capsule-carrying buggy inside the pipe was checked by means of a Geiger counter.

We had used this method quite successfully on two welds on the piping for the turbine of unit 18, installed at Fisk station in 1949. However, the heavy-walled tubing at Ridgeland station required that accurate focal lengths be used in gamma-ray photography in order to get clear definition. On the 14-in, 10-in. and 4-in. nominal sizes, it proved to be impossible to get a satisfactory picture with the radium capsule at the center of the tubing. Hence, buggies were out, and it was necessary to leave openings adjacent to the welds in which the radium capsule could be inserted.

On previous jobs using schedule 160 tubing, the gamma-ray opening was 2-in. in diameter and located near the weld. It was closed by pulling a flanged plug (inserted before the pipe weld was made) up into the opening and welding the neck of the plug to the outer wall of the tubing. The flange on the plug was seated on a counterbored seat machined into the inner wall of the tubing. We cut down the size of the opening to ½ in. (iron pipe size) by working up a special jig for positioning the radium capsule (Fig. 4). We closed the opening with a screwed plug applied from the outside of the tubing. This plug is of 2¼%-chrome, 1%-moly steel. The plug and hole are threaded to provide a minimum of 1 in. of thread and it was seal welded at its junction with the outer surface.

Using this small opening and the special jig (Fig. 5), three gamma-ray photos were taken of each weld. Each photo covers 120 deg; the definition is very good and the radium capsule can be placed very accurately. Nor has the tubing wall been weakened by a large opening.

By the time we had worked out the various details and special equipment necessary for this welding, the forged-and-bored tubing was on hand and the fabricator's shop was geared to handle this heavy material.

Fig. 6 shows the welding of the main steam piping; Fig. 7 the special sling saddles designed to hold the piping so that its exterior machined surface would not be damaged during unloading and erection.

That each part has worked out as planned is due to the intelligent coöperation of the various people who play a part in the process. Without such coöperation, the entire program could readily have been stalled.

Table I. Comparative Thicknesses of Pipe Walls

Nominal Pipe Size, In.	*Fisk station, units 17 and 18*			*Ridgeland station, units 1 and 2*		
	OD	*ID*	*Thickness*	*OD*	*ID*	*Thickness*
14	14.0	11.188	1.406	17.730	11.188	3.27
10	10.75	8.500	1.125	13.578	8.500	2.53
4	4.50	3.438	0.531	5.760	3.438	1.16
1	1.315	0.815	0.250	1.515	0.815	0.350

Table II. Breakdown of Elapsed Time Required per Weld

	14-in. pipe	*10-in. pipe*
Install heating coils	2 hours	2 hours
Preheat	2 hours	2 hours
Initial welding (1 to 1¼ in.)	24 hours	12 hours
Stress relief (raise to 1,350 F, hold)	10 hours	9 hours
Cool (600 F to 100 F)	15 hours	8 hours
Gamma-ray inspection	2 hours	2 hours
Preheat	2 hours	2 hours
Final welding	53 hours	24 hours
Stress relief (raise to 1,350 F, hold, lower to 600 F)	17 hours	12 hours
Cool (600 to 100 F)	15 hours	10 hours
Grinding	8 hours	6 hours
Gamma-ray inspection (three exposures)	78 hours	27 hours
	228 hours	116 hours

How to Beat Objections

No. 8 in a series of inspirational talks on "Twelve Self-Assignments to Sales Success"

BY RICHARD C. BORDEN

YOUR self-assignment this month is to tackle one of the most difficult problems in the entire field of human relations:

How to prove the other fellow wrong . . . and have him *like it.*

How to make a point . . . without making an enemy?

How? By answering *without heat.*

Since head-on collision always generates heat, avoid countering customer objections with contrary opinions of your own. Instead of seeming to prove that "you know better than he," shift the onus of disagreement on to the shoulders of a neutral third person . . . some other customer, for instance, whose experience with your product has been favorable.

In this way, you permit your customer to change his mind without the humiliation of being beaten in argument. You make possible a face-saving change of mind, brought about not by *your* personal victory . . . but by the introduction of new factual data that "puts the matter in a slightly different light." For arguments are not won by arguers. They are won by quiet presenters of new evidence.

These articles, published every month in THE WELDING ENGINEER, *are based on the script of a Dartnell-Borden series of sales films, "Selling against Resistance."*

1—**INSIDE JOB:** welding the 38 studs that serve as wedge guides

2—**TRANSFORMER** case tipped on side: note the studs to the rear

3—**SHOULDER** studs welded here will fasten name plate to housing

Transformers Fastened

It's no longer necessary to weld on flanges or bosses in order to get tapping depth. Stud welding saves tapping, releases drill presses for more essential work. Here's how Westinghouse Transformer Division does it.

(See front cover)

AT THE Sharon, Pa., plant of the Westinghouse Electric Corporation, the company's Transformer Division is busy turning out complex transformers, many of which must be manufactured to individual specifications. These include a carefully integrated series of control and operating components, the purpose of which is to provide the very utmost in accurate, dependable transformer action. Many of these subassembly units are larger than good-sized transformers of the low-power type.

STUDS AS WEDGE GUIDES

Studs are most commonly used to fasten two objects together, but Westinghouse engineers have developed at least one slightly different application. That's to serve as wedge guides for the coil assemblies of the company's big "Form-Fit" power transformers. Our front cover pictures $\frac{1}{2}$-in. studs being end welded to a plate that will be used in the transformer bottom section. In Fig. 1, the weldor has climbed inside the transformer to weld more studs, and in Fig. 2 we see how the transformer case looks when tipped on its side. The studs are specially pointed for quick and easy location by centerpunch marks. On each side of the case, 38 studs are welded to assure proper alignment of the various coil assemblies. Once the coils have been inserted and properly positioned, retaining wedges are driven in to assure a tight fit.

The power required for the stud-welding process is in many instances supplied by a d-c arc welder of the selenium-rectifier type; the machine used has a 220-volt primary and an 800-amp continuous-duty rating. A Westinghouse timer with a NEMA 1-A rating is hooked into the circuit to provide the proper intervals. Since the original selenium-rectifier d-c welder proved so successful for this purpose, the Transformer Division has adopted it as a standard for the many welding stations throughout the Sharon plant.

Opportunities for other studs to go to work are provided by the exterior surface of the transformer case. In Fig. 3, shoulder studs are being permanently located to fasten name plates to the housings for an operating mechanism. This completed unit will be mounted on a Form-Fit transformer. The operator in Fig. 3 will also end weld four small studs to the inside surface of the housing (around the circular opening at the right) to fasten an indicating meter in place.

The portability of the hand-operated gun is important to the manufacture of these big transformers, many of which stand as high as 20 ft. The power source (the d-c rectifier welder) is located along one side of the broad production aisle, and it is necessary to move only the 5-lb gun and the cable. Cables up to 100 ft long enable workers to do stud-welding jobs within a wide radius.

A large power transformer, under construction at the present writing for a western public utility, provides three typical examples of how stud welding serves as a time-saving production tool. For the benefit of electrically minded readers, this big transformer is rated at 35,000/43,750 kva with a 121,200-volt primary and a 13,800-volt, single-phase 60-cycle secondary. Half-inch studs with special sharp points were used along the front of the huge case to fasten the low-voltage terminal chamber to the main assembly. Once the location

4—CADMIUM-PLATED studs welded to an underground network transformer; operator is about to weld a ⅜-in. stud around an opening for a bushing

5—CENTERPUNCH locates ½-inch studs welded to bushing flanges*

by Stud Welding

of the studs has been determined by centerpunch marks, the operator quickly end welds the studs in position at an average rate of six per minute.

Brackets for a control cabinet were hand welded to the transformer shell at two points above the low-voltage terminal chamber. Two studs were end welded to each bracket as a means of supporting the cabinet when it is mounted in position on the completed unit. The third application consists of several small shoulder studs that secure a cable guard to the shell.

Underground Transformers

Many of the smaller-size types of transformers manufactured by Westinghouse also use the stud-welding method of fastening. Typical of them are underground network transformers. These units are mounted below the surface of the earth, where they are specially subject to corrosive action. Cover plates, which are mounted over the lead bushings, are fastened to the frame by cadmium-plated studs that resist rusting. Interesting sidelight in the manufacture of these transformers is the use of short sections of non-magnetic steel to reduce eddy current losses. These are inserted in slots left between the circular openings for bushings (Fig. 4).

The dozens of welding stations throughout the plant are a forceful reminder of the importance of stud welding in the manufacture of transformers. In the section where bushing flanges, rotary switch covers, tap changer covers, potheads and other transformer parts are fabricated, stud welding is one of the most common production tools.

Because of its speed and the fact that it completely eliminates drilling and tapping operations, the stud-welding method saves production time and releases drill presses for more essential work. Another factor of importance is that it is no longer necessary to weld flanges or bosses to sheet metal in order to obtain sufficient tapping depth, thus accomplishing a saving in weight.

How to Locate Studs

In Fig. 5, the operator is welding ½-in. studs to bushing flanges. Here the centerpunch method of location provides sufficient accuracy. The operator spots the workpiece and then makes a mark with the punch. He inserts a stud in the chuck of the gun, and places a protective ceramic ferrule around the end. Once the stud is positioned, all that remains to be done is to press the gun's trigger. In a fraction of a second, the weld is completed. The ferrule is simply knocked off with a tap of a hammer.

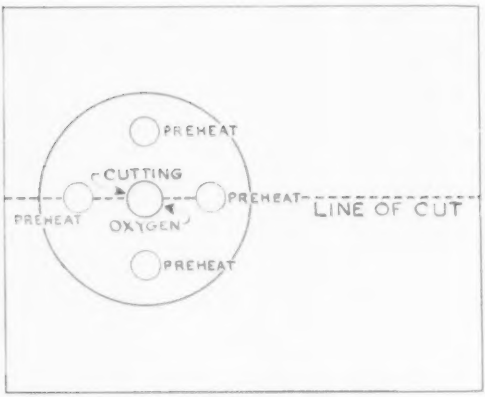
The templates stored in the background of Fig. 5 are used for many parts such as switch chamber covers, rotary switch covers, potheads and tap changer covers. The rotating storage bin on the right contains a supply of the various types of studs and ferrules needed. On the floor at the left of the picture may be seen a group of switch chamber covers to which have been welded the small shoulder studs that hold name plates in position.

The use of sheet-metal templates gives greater accuracy than location by the centerpunch method. The stud is located by a hole drilled at the proper spot in the template.

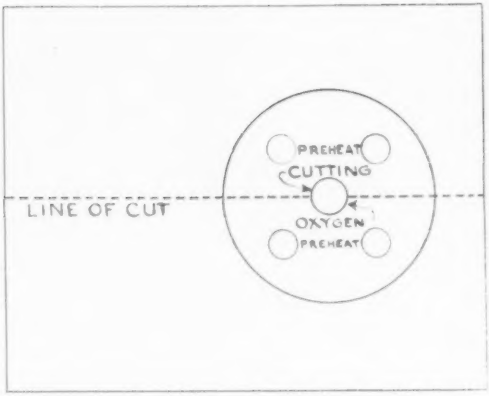
One of the most common stud-welding applications in the Westinghouse plant is that of end welding small shoulder studs to subassemblies. A typical use is on a Type URS tap changer. Four of these studs are welded to the front of the unit to hold a name plate in position. On the same unit, four small studs are welded to the inside of the front cover to fasten a meter.

Thus from the inside to the outside Westinghouse is taking advantage of the production efficiencies possible with the stud-welding method. End-welded studs are becoming important to the power distribution industry.

*Photos courtesy of Nelson Stud Welding Div., Morton-Gregory Corp.



1—SQUARE CUTS require this tip setting. Two of the preheat orifices are exactly along the line of cut



2—BEVEL CUTS require a different setting. Rotate preheat orifices 45 deg from setting for square cuts

Want to Do Better Cutting?

Follow these suggestions for setting cutting tips

BY PHIL GLANZER

THERE are just three things that will determine your efficiency in hand cutting: the condition of the torch and auxiliary apparatus, its adjustment and its handling. Even with a new torch or cutting attachment, you may improve the quality of your work—and also save oxygen—by following these suggestions. Experiment on scrap material if you want to prove their value.

Secret of Tip Setting

A little extra care in positioning the torch tip will give you cleaner and neater looking cuts, with less slag adhering to the edges. The secret lies in setting the tip so that preheat flames strike the metal in proper relation to the line of cut.

To cut a square edge at right angles to the surface of the steel, set the tip as shown in Fig. 1. Note that two preheat orifices line up with the line of cut. When you start to cut, two preheating flames should fall directly along the line of cut—one ahead of the cutting oxygen, the other following it.

When you are making a bevel cut, rotate the tip 45 deg from the position recommended for a square cut before you tighten the nut that locks the tip in place. The position for bevel cuts is shown in Fig. 2. As you can see, the preheat flames will fall to both sides of the line of cut but will not impinge directly on it. This tip setting will give the best heat distribution when the preheating flames are inclined at an angle to the surface of the steel.

Measure Bevel Cuts

When you make a bevel, you are cutting through a thickness of metal that is greater than the plate thickness, assuming, of course, that the bevel extends all the way from the top to the bottom edge. Suppose that the plate is 2 in. thick and the bevel is 45 deg. The distance you must actually cut is the square root of $2^2 + 2^2$—almost 2⅞ in. of metal. Those greater thicknesses will often call for use of the next larger size of tip and higher pressures. So measure the bevel cut—or make a scale diagram—instead of just taking the plate thickness.

Your torch will give the best results when the tip is held at the proper distance from the surface of the work. In making a square cut, just touch the surface with the ends of the inner cones of the preheating flames. For a bevel cut, move the tip away a little; preheating flames may be held ⅜ in. or more above the surface, depending on the thickness to be cut.

Keep Equipment in Shape

Your torch or cutting attachment doesn't have to be babied, but it does need a certain amount of regular maintenance for the trouble-free operation it's designed to give you. Check your equipment if the quality of your cuts is poor or if you're using more oxygen than you think you should.

Welding and cutting apparatus in need of repair wastes oxygen, acetylene and time. It may also create a fire hazard. If your equipment has been improperly used or carelessly handled, it may need repairs that can't be made without special tools. Complete repair service of factory quality is usually available through your supplier.

As a final word of advice, don't guess. Unless you *know*, consult the torch manufacturer's cutting chart to learn exactly the size of tip to use and exactly the amount of oxygen pressure. Too much pressure always wastes oxygen, but it won't speed cutting: it slows it down.

CONVENTION REPORT

(Continued from page 22)

the weld metal. Furthermore, starts are easier: even with a current as low as 15 amp.

Because of the great interest in the new metal titanium, the paper co-authored by E. M. Mahla and R. B. Hitchcock, of E. I. duPont de Nemours & Co., was also of great importance. Titanium has remarkable properties of resisting seawater and salt air corrosion (about equal to gold or platinum) and also has a promising field in high-temperature applications since its melting point is at 3,200 F. Hitchcock and Mahla used the tungsten-arc argon process to investigate the ductility and other physical properties of welds in titanium base metals containing carbon varying from 0.015 to 1.070%. Samples in the guided bend test did not fail up to 0.25% C, but ductility went down as the percentage of carbon increased. In general, welded samples ran as high in tensile strength and had about the same corrosion resistance as the unwelded base metal.

Two Airco men, Harold Robinson and John H. Berryman, found that various copper-base alloys could be welded successfully by means of the inert-gas metal-arc process using consumable electrodes. They used electrode wires of aluminum bronze, of silicon bronze and of deoxidized copper. Results were particularly good with the first two, "producing X-ray sound welds of excellent surface appearance, high physicals, with superb weldability and high deposition rates."

Clinton E. Swift and E. B. Brown, of American Brass Co., prepared the final paper, on the use of copper-alloy welding rods for production braze welding and brazing.

A good paper on the inert-arc welding of aircraft parts was presented at the simultaneous aircraft session by T. E. Piper, of Northrop Aircraft, Inc. Piper interrupted his formal presentation several times to emphasize that inert-arc welding is so fast and relatively easy that the cost of argon gas and more expensive equipment is usually offset in short time.

The third Thursday simultaneous session was on the subject of pressure vessels. The use of the multiple-layer submerged-arc process was discussed by L. C. Stiles and D. H. Curry, of Chicago Bridge & Iron Co. S. V. Williams, of A. O. Smith Corp., outlined general procedures for the fabrication of pressure vessels.

Friday Morning

The concluding day of the convention brought simultaneous sessions on inert-gas metal-arc welding, oxygen cutting, locomotives and railroads. Papers at the inert-gas metal-arc session were by T. T. Watson and R. R. Rothermel, Lukens Steel Co. (nickel and stainless clad steels); W. G. Benz, Jr., and J. S. Sohn, Air Reduction Co., Inc. (austenitic stainless steels) and H. T. Herbst, The Linde Air Products Co. (non-ferrous metals and high and low alloy steels). The paper delivered by Sohn was really an extension of the one presented by Rothermel, Sohn covering solid stainless steels and Rothermel stainless-clad steels (cladding 10 or 20% of the plate thickness). An interesting point brought out by Rothermel is that in the manual welding of clad steels both the steel and the clad sides should be welded with the same electrode—one of comparable composition to the cladding. He also revealed that when helium is mixed with argon shielding gas you secure greater penetration, but the ductility of the weld decreases as the percentage of helium increases.

Sohn's paper discussed the welding of type 304 stainless plate with type 308 electrode wire; type 304 plate with 308 extra-low-carbon wire; 310 plate with 310 wire; 316 plate with 316 wire; 321 plate with 321 wire and 347 plate with 347 wire. Tests of such weldments were made in the as-welded, annealed, sensitized and stabilized conditions.

The Herbst paper covered the high-deposition-rate possibilities of the inert-gas metal-arc process. Herbst showed a slide of the apparatus he used: a water-cooled, hand-operated torch or gun, which takes 1/16 or 1/32 in. wires. Herbst found the process satisfactory for the welding of deoxidized copper, long a tricky problem. It was not so good for copper-zinc alloys, however, because of the vaporization of the zinc.

A paper of an entirely different character was given at the same session by H. N. Hockensmith, of Brown & Root, Inc., Houston, Tex. Hockensmith described the application of the inert-gas metal-arc process to the construction of an airtight tower 155 ft high, built of sheet aluminum 61-S and containing approximately three miles of lapped and butt seams. Purpose of this large welded structure is to produce ammonium nitrate from a mixed solution of ammonia and nitric acid. As the solution is allowed to fall downward through rising cold air, it forms into small pellets (prills) of ammonium nitrate.

At the flame-cutting session, R. O. Fish, of Fairbanks, Morse & Co., showed that an accuracy of 1/32 in. is possible most of the time in the flame-cutting of circular shapes with an electronic eye device. The circle must first be blanked and then centered on a special table. R. F. Helmkamp, of Air Reduction Sales Co., also discussed photoelectrically guided flame-cutting. The savings in templates (when 20 to 50 new templates a week are needed) will soon amortize the cost of the equipment, he said. With the electronic eye apparatus, templates can be of paper covered with a plastic sheet instead of the conventional metal strips or wire.

Another Airco man, G. E. Bellew, described a new flux developed to cut high-alloy stainless steels such as 25-30 and 35-15. You need a special flux feeder, a stainless insert in the cutting tip (the flux is quite abrasive) and an abrasive-resistant hose to feed the flux to the cutting stream. However, the process will cut high-alloy stainless up to 18 in. thick, making it useful for the flame-cutting of risers, slabs, blooms, etc.

C. A. Heffernon, The Linde Air Products Co., described methods of edge preparation for welding. The most accurate set-up for welding, and the one best suited for high production rates, he said, is the "flame planer." This type of equipment processes the opposite sides of the plates simultaneously and with a really complete flame-planer set-up the ends may also be cut at the same time.

At the locomotives and railroad session, Fred T. Perry, General Electric Co., discussed the fabrication of main line and switcher locomotives. Diesel locomotive maintenance operations were handled by LaMotte Grover and R. L. Rex, both of Air Reduction Co., Inc. Reclamation and repair methods for approximately 175 items of railroad equipment at the

reclamation plant of the Chicago, Burlington & Quincy Railroad were described by W. G. Muschler. Another practical railroad man, John F. Likarish of the Great Northern Railway Co., told how welding is being used to keep in service the approximately 7,700 hopper ore cars that are used for transporting iron ore from the mines to the loading docks at the head of Lake Superior.

Awards and Prizes

Friends of Dr. Wendell F. Hess were gratified to see that he had recovered sufficiently from a long-standing illness to journey from Rensselaer Polytechnic Institute to Chicago. Hess received in person the Samuel Wylie Miller Memorial Medal from AWS retiring president O. B. J. Fraser. No man deserves this honor more than Dr. Hess, who has a long and distinguished record of "conspicuous contributions to the advancement of welding and cutting of metals." Hess, a past-president of the American Welding Society, was also the recipient of the Lincoln Gold Medal in 1944.

This year's Lincoln Gold Medal and Certificate went to Howard S. Avery, research metallurgist for the American Brake Shoe Co., for his winning paper, "Hot Hardness of Hard-Facing Alloys," published in the July, 1950, issue of *The Welding Journal*. The medal was presented by Robert H. Aborn, of United States Steel Corp.

The several resistance-welding prizes were presented to their happy winners by T. Embury Jones, president of Precision Welder & Machine Co. J. W. Kehoe, Westinghouse Electric Corp., was the winner of the $750 first prize for the best paper from an industrial source, a paper titled, "A Practical Method for Obtaining Consistent Resistance Welds."

Second prize of $500 had to be divided among three engineers of the Franklin Institute—A. O. Bergholn, P. W. Swartz and G. S. Hoell—for their paper, "Stress Distribution around Spot Welds." I. S. Goodman, another Westinghouse researcher, received the $250 third prize for his paper on "Variables in Cross-Wire Welding of Dissimilar Metals."

Dr. Georges Welter, Ecole Polytechnique, University of Montreal, Canada, was selected as winner of the $300 first prize for the best paper from a university source. Dr. Welter's paper was titled, "Fatigue Tests of Spot-Welded Steel Sheets." The second prize of $250 for a university source paper went to Dr. W. B. Kouwenhoven, of the Johns Hopkins Institute, and Dr. W. T. Sackett, Jr., of Battelle Memorial Institute, for a joint paper, "Electrical Resistance Offered to Non-Uniform Current Flow."

The A. F. Davis Undergraduate Awards were presented by Professor Robert S. Green, of Ohio State University. Howard P. Kallen, a Cornell man, won the $200 first prize for a paper, "Weldability—Challenge to Research." An equal sum was given to the *Cornell Engineer*, the student journal publishing Kallen's paper. Raymond A. DiPasquale, of Purdue University, won $150 for himself and $150 for the *Purdue Engineer*, which published his paper, "Designed for Waiting."

Business Meeting

The annual business meeting and section officers' conference took place on Wednesday evening. Harry W. Pierce was installed as president for the 1950-1951 term, and retiring president O. B. J. Fraser was given a past-president's pin by another past-president, George Sieger. Fraser was further honored by a present of a silver-mounted walnut gavel from the Hotel Sherman, where the convention was held.

Those Welded Ships Again

Financial Editor Herman Gastrell Seely, of the *Chicago Daily News*, visited the Tuesday morning ship structure session of the 31st AWS convention and listened to some highly technical conversation on the determination of stresses and results of tests on ship plates. Seely emerged with the impression that welding was directly responsible for all failures of Liberty ships that occurred during World War II. He was also of the opinion that the number of ship failures had amounted to as many as one out of every ten ships built.

Seely embodied these two ideas in a feature article, which ran in the *News* for Oct. 25 under the three-column, two-line head, "Why Liberty Ships Cracked Still a Puzzle."

"Unless the research is successful soon," Seely concluded his piece, "it looks as if Rosie the Riveter would be recalled to the shipyards in a possible future war."

Editor T. B. Jefferson, of The Welding Engineer, read Seely's article and was quick to point out the fallacies it contained. He wrote to Seely, giving the true score:

Total number of ships	1,691
Total reporting no casualties	3,724
Total sustaining casualties	970
Total serious casualties	127
Total ships lost	8

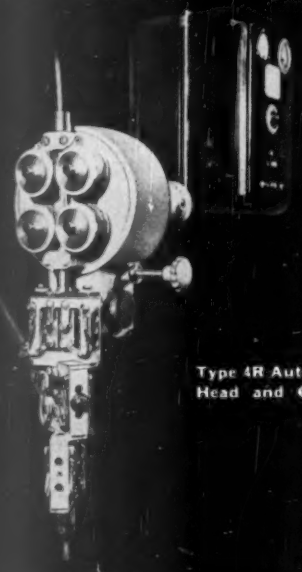
"When we look at the record," wrote Jefferson, "we find that 127 ships of welded construction—2.7% of those built under the maritime shipbuilding program—developed cracks sufficiently serious to warrant immediate repair measures. We also find that eight ships (0.17%) were lost. Even in the case of the lost ships, however, the stern sections of two of the ships were salvaged. When we start to talk about failures and end up by finding that only 0.17%, less than two ships per thousand, actually failed, it seems that an erroneous impression is being created with the public.

"Has any newspaper informed its readers that only 127 out of 4,694 ships developed serious cracks and that all but eight returned safely to port? Has the attention of the public been called to the fact that when a welded ship did crack, it was repaired by welding and put back into service?

"Has the public attention been called to the fact that riveted ships—ships like the S. S. *Leviathan* and the S. S. *Majestic*—cracked open in days long before welding was considered as a means of ship fabrication? Don't you think it is high time the public was told the truth?"

Seely and the *Chicago Daily News* made handsome acknowledgment. Seely wrote a new story headed, "Here's Weldor's Reply on Liberty Ships," and ran it with the same size of heading and in the same spot that the first article appeared. The welding industry was thus given the opportunity publicly to tell its side of the case. Let's hope that the facts will percolate.

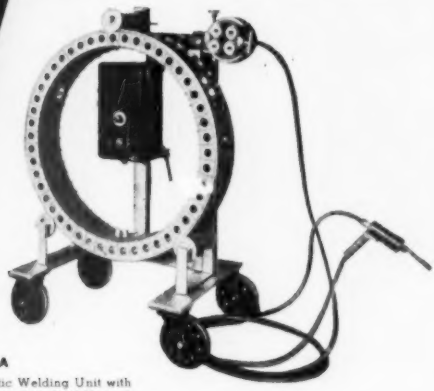
TWO NEW AUTOMATIC ARC WELDING HEADS



Type 4R Automatic Head and Control

THE REID-AVERY AUTOMATIC WELDING HEAD

THE REID-AVERY SEMI AUTOMATIC WELDING UNIT



Raco Type SA
Semi Automatic Welding Unit with reel and carriage to feed Type A heavily coated shielded arc wire. Capacity up to 5/16" wire.

TYPE 4R AUTOMATIC HEAD

The most universal welding head on the market today. Can be used with all types of automatic electrodes:—heavily coated shielded arc, lightly coated open arc. Also adaptable for submerged melt welding.

Can be used with any welding machine AC or DC.

The control is a self-contained unit with its own arc contactor for simplified wiring; just connect the welding machine cable to the arc contactor and plug in the control to the lighting circuit.

The head weighs only 38 pounds, has four driven rolls for positive feed without excessive wear or damage to wire coatings and 360° rotation with guide wheel—six mounting positions.

EXTREMELY SIMPLE CONTROL CIRCUIT
NO EXPENSIVE ELECTRON TUBES
NO EXTERNAL EXCITERS

TYPE S.A. SEMI AUTOMATIC WELDING UNIT

For those numerous jobs that do not warrant a full automatic welding fixture the REID-AVERY Type S.A. semi-automatic welding unit is ideal.

Designed to use the same electrodes as the full automatic head. The electrode is fed from the reel through a flexible tube to the welding gun at a rate proportional to the pre-set arc voltage. The operator merely guides the arc along the seam.

Note these advantages:—VISUAL ARC. Higher currents and speeds than are possible with manual electrodes—no craters in long seams—no stub end losses—simplified wiring, just connect the welding cables and plug into the lighting circuit—large rubber tired casters on carriage for portable operation.

Write For Descriptive Bulletin

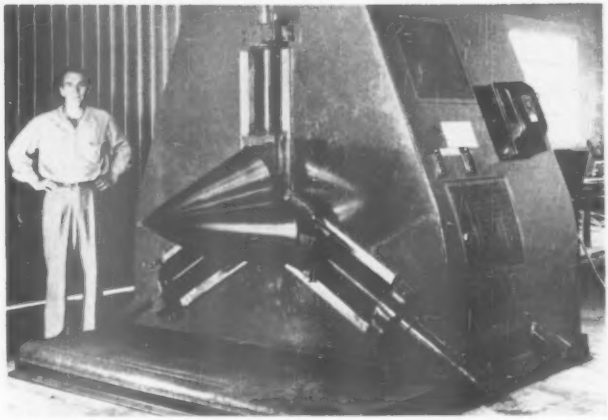
The REID-AVERY COMPANY
INCORPORATED
DUNDALK • BALTIMORE 22 • MARYLAND

It is the sales policy of The Reid-Avery Company, Inc., to market our products exclusively through distributors and agents.

Members of THE AMERICAN WELDING SOCIETY *and* THE NATIONAL WELDING SUPPLY ASSOCIATION

New products

NO MOVING parts except fan on new rectifier d-c welder simplifies operation and maintenance



JET ENGINE components are rolled on the new Reed cone-rolling machine. Each interchangeable roll is driven and adjusted separately. Rolls can include a 45-deg angle

Plate Rectifier on D-C Arc Welder

LONG trouble-free service with a minimum of maintenance is claimed for the Model SR selenium rectifier d-c arc welder. This welder has no moving parts except the cooling fan. Current source is any 220/440 volt, 3-phase, 60-cycle a-c outlet.

When the welder is on standby, it draws little current. A power switch on the control panel turns the current on and off. According to the manufacturer, this welder produces little arc blow and so is applicable to the inert-arc process or other critical uses.

Current control is of the quick-acting rheostat type, and can be adapted for remote amperage control. An accessory package containing a welding helmet, 35 ft of welding cable, electrode holder, ground cable and a wire cleaning brush is available; manufacturer also offers a three-wheeled steel truck to make the welder portable.

THE MILLER ELECTRIC MFG. CO., Appleton, Wis.

* * *

Eutectic Expands Hard-Facing Line

THE following electrodes and welding rods for hard-facing of various steels are now available from Eutectic: water hardening steel, 6WH (electrode), 5WH FC (gas); air hardening steel, 6AH (electrode), 5 AH FC (gas); oil hardening steel, 60H (electrode), 50 H FC (gas); high speed steel, 6HSS (electrode), 5HSS FC (gas); hot working tools, dies, 6HW (electrode) and 5 HW FC (gas).

EUTECTIC WELDING ALLOYS CORP., 40 Worth St., New York City 13.

* * *

Utility A-C Welder Delivers 30-100 amp

NEW small a-c transformer type welder for 50% duty cycle operation is claimed to have a range of 30 to 100 amp. Called the Model 25, it weighs 65 lb and may be connected to either a 110 or 220 volt source. It is furnished with a welding helmet, a supply of electrodes, a 6-ft ground cable and clamp and a 6-ft welding lead with electrode holder.

PRECISION WELDER MFG., CO., 5162 West Homer St., Chicago 39.

Metal Cones Produced by New Cone-Roller

THREE conical-shaped rolls are mounted in a cantilever design on the new Model R rolling machine, used to produce cones and conical shapes. Each of the three machine rolls is driven by a separate motor and each roll is adjusted independently. The rolls can be set for any position from full parallel to a 45-deg included angle. The actual forming rolls are of the interchangeable type and can be easily changed from the front of the machine.

The machine is approximately 8 by 8 by 8 ft and weighs about 13,000 lb.

THE REED ENGINEERING CO., 1003 West Fairview Ave., Carthage, Mo.

* * *

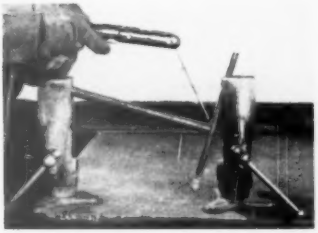
Air-Fed Hood Keeps Out Toxic Dust, Fumes

TO ELIMINATE bulk and rigidity, a new air-fed hood (No. 600) utilizes an extremely light weight, flexible rubberized fabric. It also has an extra-large clear plastic window and an adjustable plastic headband mounted on a friction swivel to allow vision up or down. Operating air pressure is 5 to 9 psi.

The hood is recommended for welding or for light sandblasting.

CHICAGO EYE SHIELD CO., 2300 Warren Blvd., Chicago 12.

for welding



New Vise Acts as Welding Positioner

LARGE holding surfaces are coupled with versatility of movement in the new "Versa-Vise" for welding jobs. Vise may be operated vertically or horizontally, will rotate through 360-deg and locks in any position.

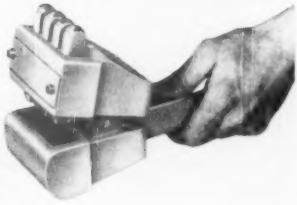
The holding surfaces are 2½ in. wide and 3½ in. deep. When the surfaces are tightened upon the object to be held, the vise locks.

Base of the vise forms a pivot, around which the vise proper turns. The vise can be placed on the base in either vertical or horizontal position for right or left-hand use.

This vise can be used on material in thicknesses up to 5 in. It is made of cast semi-steel and weighs 16 lb.

THE WILL-BURT CO., Orrville, O.

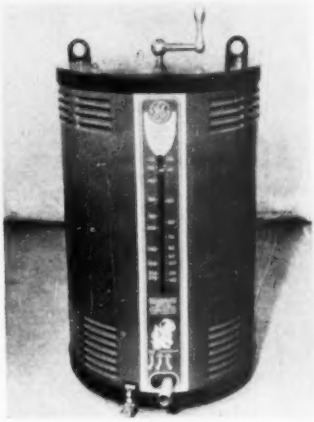
* * *



New Marker Stamps Thin Sheet, Strip

MADE from aluminum the Model JG-1 stamping tool has a holder section for almost any size or number of characters. By finger pressure, the top swivels upwards so the holder can be slipped over the pieces to be marked. When pressure is released, springs drop the top into position for marking. To complete the marking operation, each stamp is struck individually with a hammer.

M. E. CUNNINGHAM CO., 89 East Carson St., Pittsburgh 19.



New A-C Welder Has Silicone Insulation

THE new 6WK30J series of General Electric a-c welders has an automatic "hot-start" control and silicone insulation. The control is said to aid fast arc striking without any manual adjustment at the welder.

The control is composed of a sealed gas-filled time-delay magnetic switch and a wound resistor. These combine to produce a surge of increased current through the welding cable during the critical starting period. The surge is higher at low currents than at easier-to-start high current settings.

Coils of the welder are impregnated with Class H insulation, that is, asbestos, glass and mica plus silicones. Silicones aid in retaining mechanical and electrical strength at high temperatures. These welder windings are rated at the conservative temperature rise of 130 C. Current range is 40 to 375 amp.

Dimensions of the welder are 17 in. diameter and 35 in. high. Weight is 325 lb.

GENERAL ELECTRIC CO., Schenectady 5, N. Y.

* * *

Small Silver-Brazing Kit for Hobbyists, Gunsmiths

FOR users who require only small quantities of silver solder and flux, a special small kit has been assembled. It contains 33 in. of 1/16-in. silver brazing wire, 6 sq in. of silver alloy strip and a 2 oz. jar of soldering flux (Superior No. 6). There is also a brush for applying flux and an abrasive strip for cleaning.

SUPERIOR FLUX AND MFG. CO., 1302 Ontario St., Cleveland 13.

* * *

Plastic Safety Goggle Covers Regular Glasses

NEW one-piece goggle of optically correct plastic affords wide-angle vision and can be worn over most standard types of prescription glasses. The plastic is said to be impact-resistant and non-flammable.

Four point contact with the face provides good support and rolled edges and a plastic nosepiece give comfort. An adjustable elastic headband insures a snug fit.

The plastic comes in clear or green shades and may be used in chipping, grinding, machine operations, babbitting, etc.

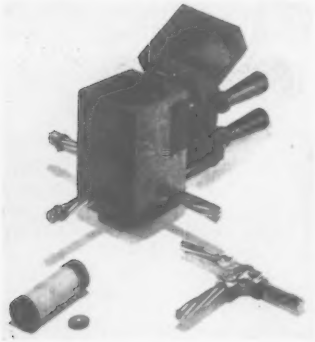
AMERICAN OPTICAL CO., Southbridge, Mass.

* * *

Heavy-Duty British Holder Has 500-Amp Capacity

MODEL H500 electrode holder produced by Murex has grooved jaws to hold electrodes and can be used for currents of 100 to 500 amp. Jaws are made of a special alloy that has a high resistance to both burning and to welding spatter. All of the copper parts are sheathed in a new insulating material, and the hand grip is protected by a circular guard

MUREX WELDING PROCESSES, LTD., Waltham Cross, Herts, England.



Cable Connecting Process Thermit Welds Copper

FOR connections in welding and other cable, the new "Cadweld" process produces a solid homogeneous copper nugget between the cable sections. Equipment used includes a small graphite crucible (see picture above). A mixture of powdered copper oxide and aluminum is ignited by a spark from a flint spark gun. The resulting reaction, taking about ten seconds, causes molten copper to flow over the cleaned cable ends in the graphite mold to make a single copper mass.

The process may also be used for terminal lugs. The graphite crucible comes in two sizes. Model 263 handles 1/0 and 2/0 cable. Model 262 handles 3/0 and 4/0 cable.

Connections can be made at the rate of one per minute. The taped joint is about 3-in. long.

ERICO PRODUCTS, INC., 2070 East 61st Place, Cleveland 3.

* * *

Metal Safety Goggle Is Strong, Light

DESIGNED to provide superior eye protection from flying particles, the new F1100 "Ful-Vue" metal goggle has several new features. The lightweight eye wire is flat rather than round. Temples are lighter, easily adjusted and have perspiration-proof insulating tubing over the ear portions.

Side shields, to provide protection against laterally striking particles, are optional. They may be either of non-corrosive perforated wire mesh or of clear acetate, perforated or non-perforated.

Goggles are supplied in three standard eye sizes and five standard bridge sizes.

AMERICAN OPTICAL CO., Southbridge, Mass.

* * *

Stronger Palm, Thumb on New Work Gloves

WORK gloves with a continuous seam on the back of the all-leather thumb are said to have longer life and greater strength. All seams on fingers are also on the back. The palm is seamless to aid in handling rough work without tearing. The glove is lined with white canton flannel and is available in two types; the "Wing-King" with 4½-in. gaultlet and the "Super B" with 2½-in. safety cuff.

RICHMOND GLOVE CORP., Richmond, Ind.

* * *

Cobalt-60 Radiography Open to Industry

COBALT-60, an atomic-pile-produced radioisotope, is now available for routine industrial radiography. Its comparatively low cost makes the advantages of intense sources available to small fabricators, railroads and laboratories. The isotope comes in 200 and 400 millicurie sizes, sealed in thin-walled stainless steel containers. A lead-shielding container is available.

The U. S. Atomic Energy Commission requires that each potential user file an "Acceptance of Terms and Conditions" form with the AEC and also make out an "Application for Radioisotope Procurement" form (Form AEC-313a) for each isotope shipment. Most important requirement made by the AEC is that the person in charge of the isotope be sufficiently trained and experienced in the use of radiation to prevent injury to personnel. Forms are available from Tracerlab, Inc., Boston, or the AEC at Oak Ridge, Tenn.

TRACERLAB, INC., 130 High St., Boston 10, Mass.

* * *

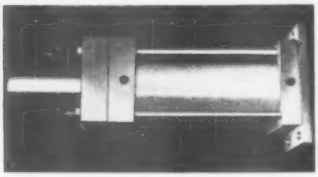
Small English Welder Spot Welds Jewelry

SMALL 4-kva spot welder made by an English firm spot welds radio and electrical parts, surgical instruments, jewelry and watch equipment.

An electronic control circuit holds the welding time accurately between 1 and 6 cycles. A low-inertia electrode holder provides quick-follow-up.

THE GENERAL ELECTRIC COMPANY, LTD., Magnet House, Kingsway, W. C. 2, London, England.

* * *



Air-Operated Accumulators Store Fluids at 10,000 Psi

LOW-PRESSURE, air-operated accumulators store fluids at up to 10,000 psi pressure. Ordinary plant air at 60-200 psi is used as the compressible medium. In pump circuits, oil flows from the pump into the accumulator during the non-demand pump cycle. The oil, under the high pump pressure, works against a hydraulic piston driving a larger air piston that in turn works against a low-pressure air medium. The oil is thus stored at pressures up to 10,000 psi, for either immediate or later discharge, usually at high flow rates of short duration.

By changing their circuit connections, these accumulator units can be employed as "boosters" with either plant oil or air line pressure used as the input medium.

MILLER MOTOR CO., 4027 North Kedzie Ave., Chicago 18.

NEW PRODUCT BRIEFS

Hot incandescent work lights can be quickly converted to cool fluorescent light by simply screwing a "Lite-Mite" bulb into the socket. The new bulb can be rotated 300-deg for added flexibility. Two 4-watt fluorescent lamps are in the "Lite-Mite."

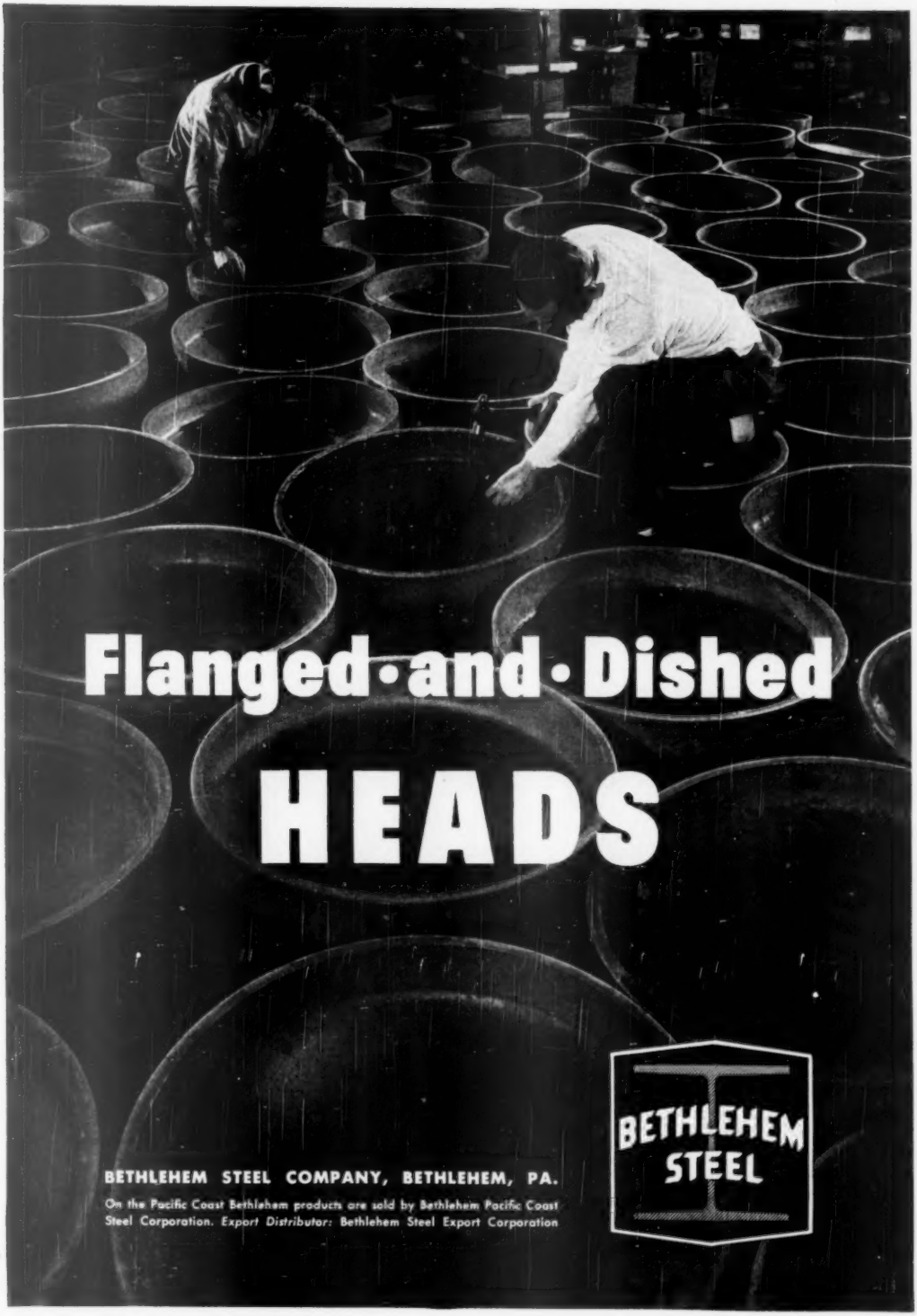
STOCKER AND YALE, Marblehead, Mass.

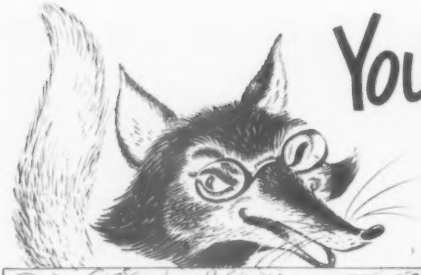
* * *

Combination polisher-sander, Model No. 125 can finish flat, concave or convex surfaces of wood, metal and plastics. A 6-in. rubber backing pad, 6½-in. lamb's wool bonnet and three 6-in. sanding discs come with the polisher.

CUMMINS PORTABLE TOOLS, Div. of Cummins Business Machines Corp., 4740 Ravenswood Ave., Chicago 40.

(*Continued on Page 80*)

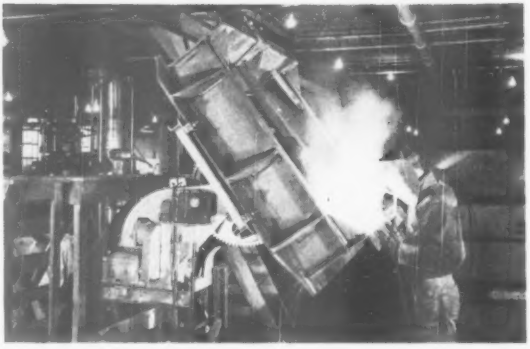

Flanged·and·Dished
HEADS
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation
BETHLEHEM STEEL



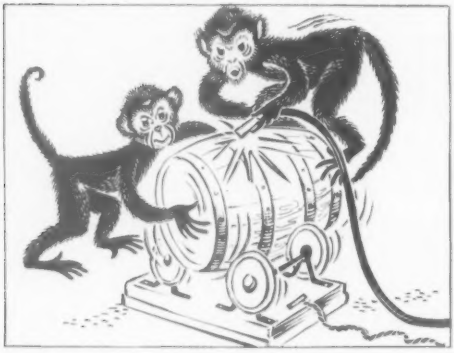
You're Smart Like a Fox...

when you increase arc-time per hour with Worthington-Ransome Welding Positioners and Turning Rolls.

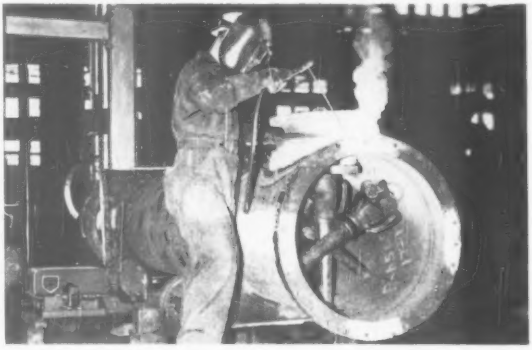
Not this... Spare your welders the chore of having to *climb* all over the work piece. Climbing, turning, propping time is *waste* time.



But this With a Worthington-Ransome Welding Positioner continually bringing work into position for convenient down-hand welding, your welders spend less time handling, more time welding.



Not this... Why do it the hard way when you can get it done the easy way?

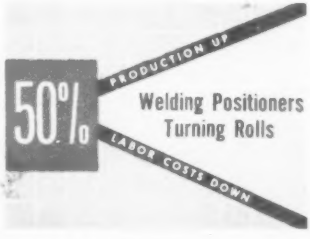


But this Manual or automatic welding really pays off when you use Worthington-Ransome Turning Rolls to rotate the work. This way, output goes up as much as 50% on either repetitive or job work.

Welding Positioner capacities from 100 lb to 20 tons. Turning Rolls from 3 to 150 tons, stationary and self-propelled.

Write for Positioner or Turning Roll Bulletin, Worthington Pump and Machinery Corporation, Welding and Assembly Positioning Equipment Division, Dunellen, N. J.

WORTHINGTON



How Many Pounds to the Gallon?

BY W. F. SCHAPHORST

SUPPOSE some one asked you to build a welded tank to hold a certain number of gallons of oil. Undoubtedly, one of your first questions will be: how much is the oil going to weigh? Unless you know, you can't design a tank that will hold and support its contents with the proper safety factor and yet not be unnecessarily heavy and expensive.

Before you start building the tank, it may be necessary to convert the number of gallons into cubic feet. If your dimensions are to be in feet and inches, the volume of the tank should certainly be expressed in cubic feet so that you will have a common basis for computation.

Questions such as how many pounds, how many gallons and how many cubic feet are conveniently answered by the accompanying nomograph with no more trouble than drawing a line or laying a straightedge from one scale point to another.

Example: How many cubic feet are equivalent to 150 gallons? What's the weight of that amount of Diesel-engine oil?

Find 150 gallons on scale B. It's opposite the 20 mark on scale A, so 20 cu ft is the answer to the first question. Actual computation gives 20.055 cu ft, very close to the scale value. Columns A-B are a "conversion scale"; you can read cubic feet on one side and the corresponding number of gallons on the other.

To find the weight of the oil in the above example, connect the 20 on scale A (or the 150 on scale B) with the point in column D labeled "Diesel-engine oil"; the intersection with scale C will give the answer: about 1,060 lb. The dotted line has already solved this problem.

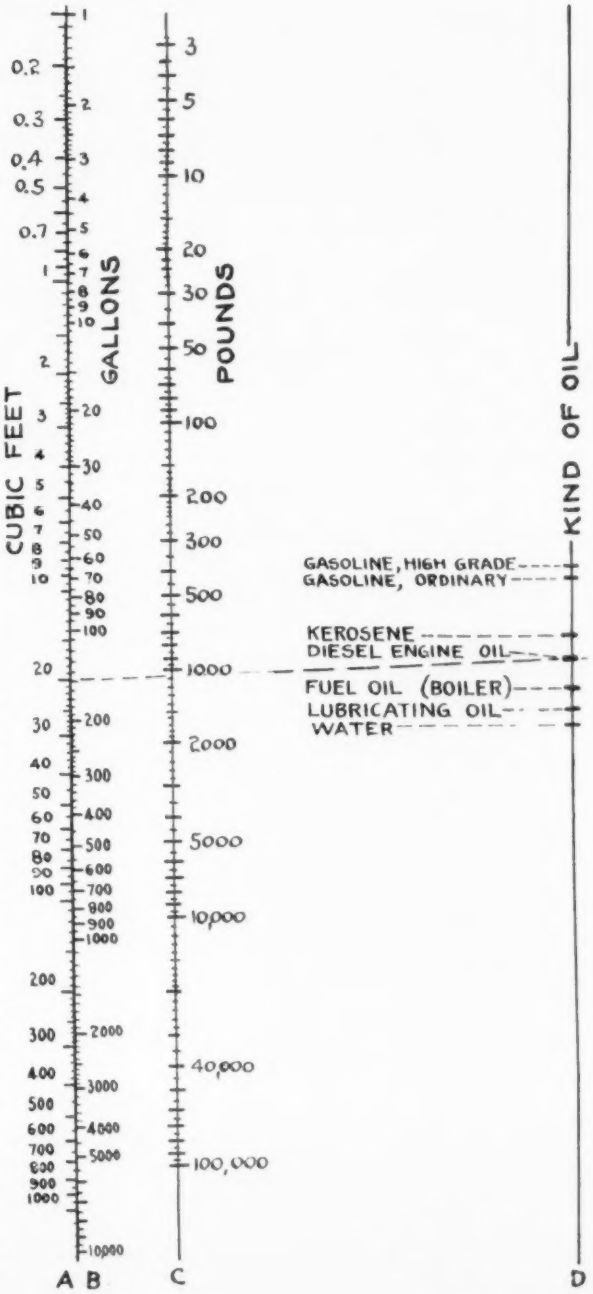
If you know the kind of oil and how much it weighs but don't know the number of gallons, draw your line between the proper points on scales D and C and prolong it to intersect scales A-B. That will give you the answer in either cubic feet or gallons.

The weight scale runs from 3 to 100,000 lb. Quantities under or over can be calculated by shifting the decimal point. In the preceding example, for instance, suppose that you have 20,000 cu ft of oil instead of 20 cu ft. Then you add the same number of ciphers (in this case three) to your answer that you added to the 20. Instead of 1,060, you will have 1,060,000 lb or 530 tons. That's all there is to it.

To extend further the usefulness of the chart, water is included on scale D along with the various kinds of oils. Thus you can find the weight of a given volume of water, expressed in either gallons or cubic feet. Or you can translate a given weight of water into cubic feet or gallons.

Maybe you feel that the chart is all right for quick, rough estimates, but that you would like to work with more accurate figures in your final design. In case you want to make your own computations, by arithmetic or on a slide rule, the chart is based on the following weights per gallon:

Gasoline, high grade	6.00 lb per gal
Gasoline, ordinary	6.12 lb per gal
Kerosene	6.81 lb per gal
Diesel-engine oil	7.09 lb per gal
Fuel oil	7.50 lb per gal
Lubricating oil	7.58 lb per gal
Water (at 68 F)	8.33 lb per gal



New! VICTOR
CUTTING TORCH
with Stainless Steel Head
and Tube Assembly

CTS-400 Series

Rugged stainless steel tip nut, head and tubes.

Uses all standard Victor cutting tips.

New high-capacity, cutting oxygen valve—operated over half million times without detection of wear.

New oxygen and fuel control valves with "O" ring pressure seals—no outmoded packing, no take-ups, no adjustments needed.

Test it ***on your severest cutting job . . . see for yourself how fast it cuts, how cool it stays.***

Here's the torch you've been waiting for. Cuts longer and faster than other torches without overheating because mixer and mixer tube are made of high-heat resistant copper alloys—no danger of mixer failures from overheating. Mixer itself is Victor's famous spiral mixer, designed to prevent backfire and flashback.

The stainless steel head and tube assembly is a single unit and can be replaced without buying a complete torch. Comes with either 90° or 75° head. Standard length is 21"; 27" or longer available on special order.

Call your Victor dealer NOW . . . ask him to demonstrate this new, stainless steel torch on your toughest cutting job.

VICTOR

Welding and Cutting Equipment Since 1910

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A Welding Engineer Reader Service

1 WELD CHIPPING—Master Pneumatic Tool Co., Inc., Orwell, O. 6-page, two-color folder pictures and lists specifications for weld chipping tools, grinders, wire brushing tools, grinding wheels, abrasive points, and air tool accessories.

2 PLOW SHARE WELDING—Wiese Plow Welding Co., Inc., Perry, Ia. 20-page, wire-bound booklet with stiff covers describes the Wiese patented method for sharpening, pointing and reclaiming worn plowshares. Clamps, tables, repoints, hard-facing alloys, landside shims, planter runners, etc., are shown and discussed.

3 GRINDING STAINLESS — The Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J. 6-page, pocket-size folder tells about abrasive wheels for grinding stainless alloys. Specific recommendations for castings, forgings, corner seams, tubing, etc., are given and explained.

4 TUNGSTEN ELECTRODES—Fansteel Metallurgical Laboratory, North Chicago, Ill. 4-page bulletin 1.102-1 tells about Fansteel tungsten electrodes for inert-arc welding. It lists standard diameters, lengths, and practical suggestions for longer life, better welds, lower costs.

5 CABLE CONNECTOR—Cam-Lok Connector Co., Cincinnati 6. Single-sheet bulletin describes a quick detachable connector with cam action locking. Sizes available, offset angle models and prices are listed.

6 SILVER BRAZING FLUX—Goldsmith Bros. Smelting and Refining Co., 1300 West 59th St., Chicago 36. Single sheet, two-color bulletin tells about two types of flux for silver brazing and lists their prices.

7 SAFETY GOGGLES—United States Safety Service Co., Kansas City 6, Mo. Single-sheet, two-color bulletin tells about the "Saf-I-Duo" combination safety goggle and spectacle. The interchangeable lens feature is explained and lens recommendation for various duties are tabulated.

8 WELDING CATALOG—Delta Mfg. Div., Rockwell Mfg. Co., Milwaukee 1. 60-page Delta catalog gives details and pictures of the new air-operated Delta spot welder and tells about other tools in the Delta line of 53 machines, 246 models and 1,300 accessories.

9 DISC GRINDERS—Gaston Power Tools, Inc., Harvey, Ill. Single-sheet bulletin gives pertinent data on Gaston heavy-duty grinders for finishing welds. Edge grinders, polishers and accessories for the Gaston tools are also pictured and specifications listed.

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10 THORIATED TUNGSTEN ELECTRODE—Air Reduction Sales Co., New York City 17. Single-sheet bulletin ADC 668 tells about the new thoriated tungsten electrodes for inert-gas welding. Advantages of the new material as far as contamination, arc stability, economy and arc starting are explained.

11 POWDER CUTTING—The Linde Air Products Co., New York City 17. 8-page illustrated booklet, "Powder Cutting and Scarfing Processes," tells about these processes in the fabrication of stainless and cutting of heavy steel scrap. Chemistry, metallurgy and equipment used are described.

12 WELDING CLAMPS—Adjustable Clamp Co., Chicago 22. Single sheet bulletin No. 104 shows more than 10 types of "Jorgensen" welding clamps and tells about their locking properties, holding strengths, spatter-resistant qualities and other characteristics.

13 ACETYLENE GENERATOR — Smith Welding Equipment Corp., Minneapolis 14. 6-page pocket-size folder shows a phantom view of the Smith Type K acetylene generator with all features pointed out and clearly explained. Three sizes of portable generators are also illustrated.

14 WELDING POSITIONER—Aronson Machine Co., Arcade, N. Y. 4-page Bulletin HD-1 pictures and describes construction, operation, and application details of a heavy-duty gear-driven welding positioner. Specification and load capacity figures tabulated for 7 models.

15 BENCH WELDER—Raytheon Mfg. Co., Waltham 54, Mass. Single-sheet Bulletin DLW-221 illustrates the Model G "Weldpower" bench welder for light spot, series, percussion and press type welding. Operating features such as special follow-up mechanism are explained. Specifications and dimensions are tabulated.

16 SILVER-BRAZING CATALOG—Handy & Harman, New York City 7. 24-page, two-color Bulletin 20 tells about applications, techniques and materials for all types of silver brazing. This complete booklet covers processes, joints, fluxing and finishing.

17 SOAPSTONE HOLDER—Randall Mfg. Co., North Kansas City, Mo. 4-page two-color bulletin shows the Randall soapstone holder for welders, blacksmiths and boilermakers. Other welding items shown are spark lighters, cylinder trucks and tip cleaners.

18 TURNING ROLLS—Worthington Pump and Machinery Corp., Welding Equipment Division, Harrison, N. J. Single-sheet, two-color bulletin R-1700-B4 tells about the Model 75 turning rolls. Rollers, gears, idlers, drive, bearings and capacity are listed and explained.

19 THREE-PHASE WELDING — Sciaky Bros., Inc., Chicago 38. 8-page Bulletin 136-A describes the Sciaky balanced 3-phase system of resistance welding. Oscillograms, sample welds and typical machines are also shown.

20 D-C REMOTE CONTROL—Foster Transformer Co., Cincinnati 23, O. Single-sheet bulletin shows the Foster remote control electrode holder, control box and connector for efficient d-c arc welding. Operating principles and installation problems are discussed.

21 LOW-TEMPERATURE ALLOYS—Eutectic Welding Alloys Corp., New York City 13. 4-page folder EU 77 shows photomicrographs of various Eutectic low-temperature welding and brazing alloys for cast iron, sheet aluminum, extruded brass, hard-facing and mild steel.

22 RECTIFIER WELDER — Miller Electric Mfg. Co., Appleton, Wis. Single-sheet bulletin pictures and describes the new Miller plate-rectifier type 360-amp d-c arc welder. Operating features and other specifications complete the description. See page 44.

23 CABLE SPLICING—Erico Products, Inc., Cleveland 3. Single-sheet bulletin shows the simple tools necessary to make a fused copper "Cadweld" splice in welding cable. Pictures show finished joint and operation of tools. See page 46.

24 GAS WELDING CATALOG—National Welding Equipment Co., San Francisco 5, Calif. 16-page booklet in four-colors clearly shows welding torches, regulators, complete welding outfits, and cutaway diagrams of working parts and special features.

25 WELDING LENS—B. F. McDonald Co., Los Angeles 37. Single-sheet bulletin describes the "Burt-Weld" lens for reducing welding glare in aluminum welding. Specifications the lens meets are added.

26 ACCUMULATORS — Miller Motor Co., Chicago 18. 12-page, two-color Bulletin B-200 explains the operation and application advantages of Miller accumulators for use on industrial hydraulic systems. See page 46.

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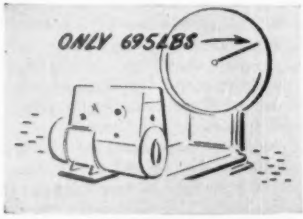

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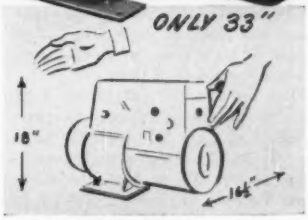

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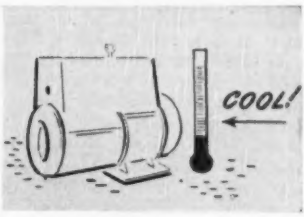

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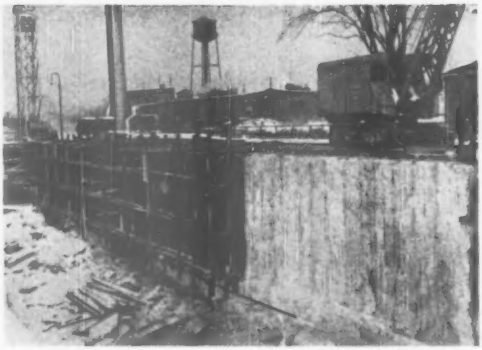
on the job

HINGED PLATE towards right maintains air compressor in a steady vertical position. Notice the diagonal braces that hold it in place



Courtesy A. M. Byers Co.

INSTALLING facing plates for lock wall. Wrought-iron sheathing will protect the wall of the chamber against abrasion and corrosion

Collapsible Compressor Frame

By M. H. Pearce

AIR COMPRESSORS of the portable type are widely used on construction jobs to furnish the air that powers small tools. To minimize vibration, the compressor is usually mounted on a post sunk deeply into the ground. Instead of the post, the welder for one contractor provided a steady mounting that would simplify moving.

The picture at top left shows how he made it. At the bottom is a rectangular skid of 4-in. pipe that can be placed quickly and moved to accommodate the length of the steam and air lines. He welded a heavy steel plate near one end of the pipe skid and hinged to it a second plate of the same material. The mounting bolts of the compressor were attached to this hinged second plate. Just below the upper bolt holes, there was welded a cross member. The cross member extended beyond the swinging plate yet was short enough to fall wholly within the longitudinal pipes of the skid.

Ears or bearings for bolts were mounted at each end of the cross member. Two braces, each a bar $\frac{3}{4}$ by 4 in., were fitted between the ears on the cross member and ears similarly mounted to a horizontal plate across the other end of the skid. Split cotters fix the bolts that hold the two braces in place.

When it's necessary to move the compressor to another location, the frame is dismantled by pulling out the upper locking pins. That allows the plate with the compressor to be lowered downward to rest across the lower hinge member. The two braces are then laid across the cross arm and pinned between ears on the larger base plate. Thus secured, the compressor is held firmly and requires a minimum of space for its transportation. As a final advantage, no pipe fitting is required when the unit is moved.

* * *

Making Salt Bins

IN MINNEAPOLIS, the Day Company fabricates steel and alloy products for food and chemical industries. Recently, the company had an order to build some aluminum salt bins. Each bin was to have an overall height of 10 ft 3 in., while diameters ranged from 6 to 8 feet.

The bins were fabricated from 61S-T6 aluminum of various gages through $\frac{1}{4}$ inch. The inert-arc welding process rendered special cleaning unnecessary. No preheat had to be used. Because of the bulkiness of the bins, however, many welds had to be made in the vertical-up and vertical-down positions.

Courtesy General Electric Co.

INERT-ARC welded aluminum salt bins are 10 ft 3 in. high, from 6 to 8 ft in diameter

* * *

Canal Locks Iron-Sheathed

WALLS OF the chambers of canal locks are exposed to the chemical action of dirty water, to the effects of alternate freezing and thawing, wetting and drying and to the severe abrasion caused by barges scraping against the sides. Little wonder that the concrete cracks and spalls!

To preserve the concrete for longer service, Lock No. 24 at Baldwinsville, N. Y., Erie division of the New York State Barge Canal, was given a protective sheathing of $\frac{3}{8}$-in. wrought-iron plate. Welding joined the 6 by 36 ft sections into a continuous iron wall.

So badly chipped was the north wall of the 300-ft-long lock that about a foot of it had to be blasted away with dynamite. I-beams were then temporarily attached to the outer face to facilitate handling and aligning of the iron plates. Butt straps were cinch-anchored to the wall base to aid in alignment. The plates were attached to the wall by the cinch anchors and wrought-iron bolts. The ends of the bolts were plug welded to the plates.

The one-foot space left between the original lock wall and the wrought-iron facing plates was back filled with concrete.

The south wall of the lock had been repaired in similar fashion back in 1936. Inspection revealed no damage nor signs of loosening in the wrought-iron facing plates and no evidence of corrosion.

Courtesy The Linde Air Products Co.
CRACKED CYLINDER of steam hammer was back on the job after a repair of 14 hours

Back Because Braze Welded

BRAZE WELDING, as defined by the American Welding Society, uses a non-ferrous filler metal of melting point above 800 F but below that of the parent metal. The filler metal is deposited in a groove, fillet, plug or slot. The latter requirement marks the fundamental difference between braze welding and brazing, in which the joint is closely fitted and the filler metal is distributed by capillary attraction.

Using proper procedures, braze welding makes a repair as strong as the original part. Broken castings can be returned to service within a few hours. Braze welding is fast because little or no preheat is needed. For best results, the welding rod should have a low melting point, tin easily and solidify quickly.

As an example of a braze-welded repair, consider the cast-iron cylinder in the accompanying picture. This cylinder for a steam hammer weighs about two tons. Two large cracks, one on each side of the cylinder wall, were braze welded in only 14 hours. A new casting would have taken 12 to 16 weeks to obtain and would have cost ten times more.

As another example, the steam chest of a tugboat cracked. The crack, running diagonally across one wall of the $\frac{5}{8}$-in.-thick casting, was extended through the flange to allow for expansion during welding. The area of the break was torch heated before, during and after welding. The tugboat was back on the job within a few hours.

Worn castings may be reclaimed by the closely related process of bronze surfacing. An instance is provided by water wheel blades, rebuilt to original size with metal deposited from bronze rods.

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Every day more and more fabricators are learning that GB Silver Solder with GB Flux makes an unbeatable production team for low temperature brazing.

From the GB line of six standard silver solders you can select the one which will fully meet your production specifications. Yes, with GB Silver Solders you get sound, low-cost joints on virtually any ferrous or non-ferrous metal.

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GB No. 41 Silver Solder, melting range 1125-1160°F
GB No. 35 Silver Solder, melting range 1130-1270°F
GB No. 31 Silver Solder, melting range 1130-1300°F

For special jobs where special silver solders are required, GB offers you competent technical assistance, backed by over 80 years of experience in alloying and refining precious metals.

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MEMBERS of the Society for Non-Destructive Testing examine an X-ray diffraction machine during a Milwaukee plant tour in October

ALUMINUM WELDING demonstration for welders and engineers in four southern cities was staged by Southern States Iron Roofing Co.

NEWS

SNDT Members Tour Milwaukee X-ray Plant

ONE of the highlights of the annual meeting of the Society for Non-Destructive Testing held in Chicago (see also page 29) was a tour of the General Electric X-Ray plant at Milwaukee on Friday, Oct. 27. The top left picture was snapped as a group looked at a direct-recording X-ray diffraction machine, set up for fluorescence analysis.

Left to right are: J. W. Ranftl, General Electric X-Ray Corp.; G. H. Tenney, Los Alamos Scientific Laboratory, Los Alamos, N. M.; Mrs. Tenney; Arthur Berman, also of Los Alamos; James Bly, materials engineer, Pratt & Whitney Aircraft Corp., East Hartford, Conn.; and N. C. Miller, Los Alamos.

* * *

How Weldments Behave at Below-Zero Temperatures

A NEW report by the Society of Automotive Engineers tells how proper heat-treatment, design and metallurgical considerations affect welded assemblies at sub-zero temperatures. The 97-page report, "Low Temperature Properties of Ferrous Materials," tells ways to get crack-free, tough weldments for various material combinations that must be in service at low temperatures. It includes 62 illustrations and 22 tables.

Among important subjects discussed are: methods of reducing stress concentrations; selection of steels; effects of large steel masses as opposed to thin high-strength sections; chemical analyses; grain structure, etc.

Dr. C. H. Lorig, Battelle Memorial Institute, headed the 11-man group, under the SAE Iron & Steel Technical Committee, that wrote the report.

* * *

Predicts Shortage of New Engineers

CONSIDERABLE decline in enrollment in freshman engineering classes in September of this year has caused some concern among educators. Dean Thorndike Saville, New York University College of Engineering, reports that the huge number of engineering graduates following World War II have all been absorbed by industry, so there is bound to be a shortage of engineers if demand for them continues as high.

Partly to blame for the lowered enrollment, Dean Saville asserted, were several news releases and stories issued late in 1949 and in the spring of 1950. These gave a pessimistic outlook on the number of engineering jobs available. However, just the opposite view is more like the truth. Studies by the Manpower Survey Committee of the Engineers Joint Council and by the manpower committee of the American Society for Engineering Education show a possible shortage as early as June, 1952.

Roofing Company Sponsors Aluminum Welding Clinics

MORE than 500 welders, engineers and metal workers in Atlanta, Memphis, Louisville and Birmingham were shown the latest aluminum welding methods in clinics held recently by Southern States Iron Roofing Co., Savannah, Ga. Coöperation of the Reynolds Metals Co. was provided in the person of Charles Bruno, an aluminum welding specialist.

Mr. Bruno demonstrated acetylene welding jobs such as brazing of light sheet aluminum, welding of light sheet, extruded pipe, shapes and tubing. He also showed how d-c welders and coated aluminum electrodes can be efficiently used on structural work.

Latest equipment for inert-gas-shielded arc welding was shown, including the manual torch, inert-arc-spot gun and inert-arc metal-arc gun. The demonstrations cover sheet, tubing, piping, extruded forms and rolled structurals, ranging in thickness from 0.032 to 0.125-in.

The inert-arc metal-arc process has been used on 2½-in. thick plates of aluminum, Mr. Bruno explained.

* * *

Alcoa Establishes Fellowship at Rensselaer Polytechnic

MUCH valuable research in aluminum alloys and their weldability has been carried on at Rensselaer Polytechnic Institute, Troy, N. Y., since 1942. In recognition of this fact, the Aluminum Company of America has established a $3,500 fellowship at Rensselaer. A check for $3,500 was recently presented to Dr. Wendell F. Hess, head of the metallurgy department, by Dr. E. H. Dix, Jr., assistant director of research at Alcoa's New Kensington, Pa., Laboratories.

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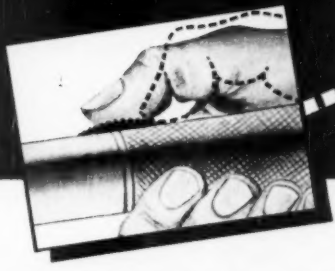

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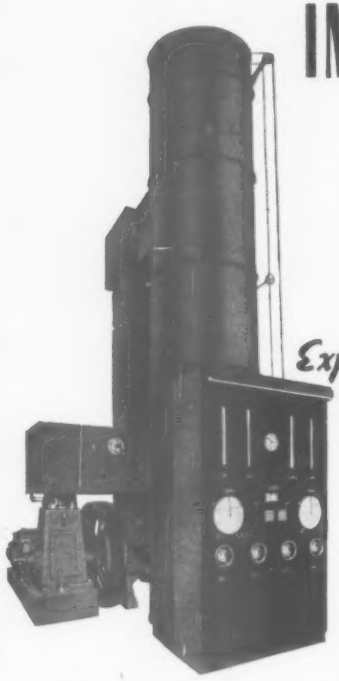

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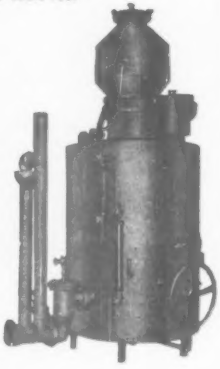

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O'FALLON 5, ILLINOIS

Welded Bridge Awards Announced by Lincoln

AWARDS of $10,750 have been made for the best designs for welded bridges submitted to the 1950 Welded Bridges of the Future Program sponsored by the James F. Lincoln Arc Welding Foundation. Competition attracted designers from 16 countries.

First award of $5,000 went to James H. Jennison, head of the development engineering division, U. S. Naval Ordnance Test Station, Pasadena, Calif. Second award of $2,500 went to Ernest Amstutz of Zurich, Switzerland. Professor Thomas C. Kavanagh, department of civil engineering, Pennsylvania State College, State College, Pa., won third prize of $1,250.

Ten honorable mention awards of $200 each went to M. S. Zakrzewski and J. R. Daymond, Durban, South Africa; Arsham Amerikian, Chevy Chase, Md.; John E. Kayser, Roseland, N. J.; J. W. Briscoe and E. R. Bretscher, Urbana, Ill.; Kazimierz Lecewicz and Wlodzimierz Gorgolewski of London and Wembley, England; John A. DeLong and A. A. Brielmaier, St. Louis, Mo.; John Turner Percy, Troy, N. Y.; Sidney Rochlin, Los Angeles, Calif.; I. L. Hamilton, Lanarkshire, Scotland; and Kenneth Warren Dobert, Troy, N. Y.

The program is concerned with the building of better bridges for less money and with less steel. According to Dr. E. E. Dreese, chairman of the board of trustees of the Lincoln Foundation, welded bridges designed for this program could be built today with 20 to 30% less steel than would be required for equivalent riveted bridges.

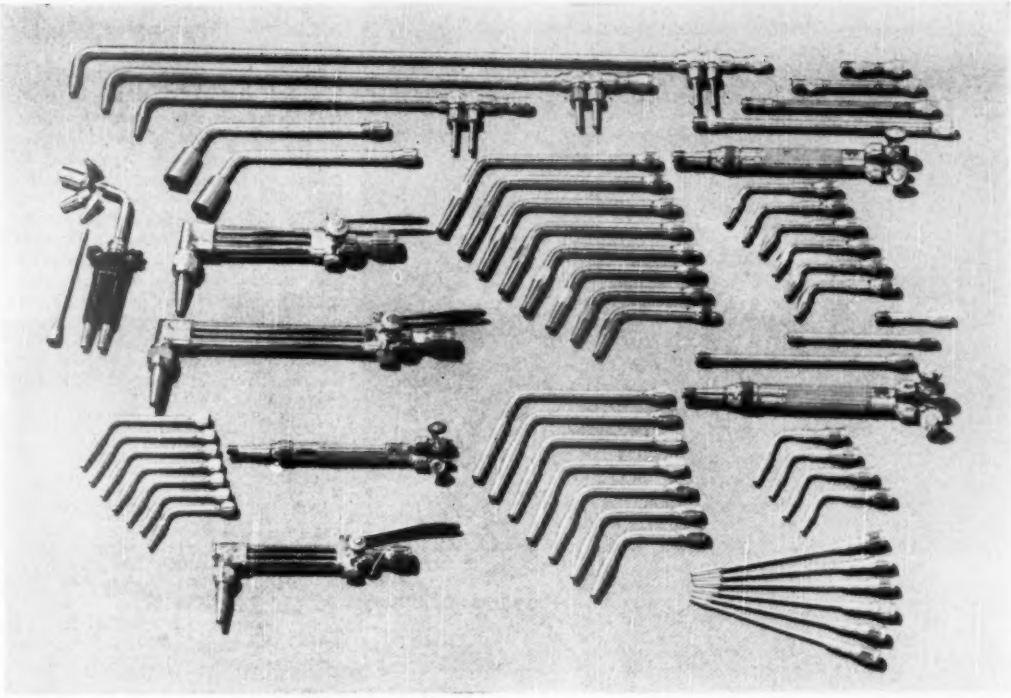
* * *

New Raynolds Booklet on Welded Aluminum Structures

BASIC information on how to design load-carrying structures in aluminum is presented in the 1950 edition of "Aluminum Structural Design," issued by the Reynolds Metals Co., Louisville, Ky.

Fabrication considerations (including arc and spot welding); tensile, compressive and bending stresses; deflection and vibration problems and special formulas are discussed in the book.

There are 66 pages of tables on physical, chemical and mechanical properties, sizes, alloys, tempers, sections, shapes, etc. The book contains 130 pages, 144 illustrations and three indexes. It measures 6 by 9 in., is wire bound to lie flat when open.



FLAMES FOR EVERY USEFUL PURPOSE

this NATIONAL welding torch has lived a long time—

since 1910 — and during these four decades it learned a lot . . .

During the past forty years, the *NATIONAL* welding torch has learned a lot and acquired a very comprehensive family of tips, nozzles, and attachments for every desirable welding, soldering, brazing, lead burning, preheating, or flame-cutting purpose.

For the really "hot" job, it offers fully water-cooled nozzles which are light enough to handle with ease, strong enough to stand the "gaff", and keep a truly "cool" head.

Torch extensions, in useful lengths, and full sets of nozzles give the operator an ample choice of flame sizes and flame characteristics.

Multiple flame heating nozzles, available for use with acetylene or the liquefied petroleum gases with oxygen, complement the over-all usefulness of this fine and sturdy group of welding torches.

And for flame cutting . . . you have a choice of cutting attachments which are as sturdy as they look, as well designed as their outward beauty suggests, and as efficient as any cutting torch you have ever employed; and *safe* to handle. Each of the gases is conducted to the torch head in individual tubes, carefully and dependably silver-soldered. *There are no tubes within tubes* which, should a leak occur, could create a hazardous condition right in the operator's hand . . . and that is *important*.

Forty years of experience — maximum safety — the greatest choice of useful and economical flames.

Made by National WELDING EQUIPMENT CO., San Francisco 5, California

Rotate Tip in any direction *even while flame is burning!*

PLUS THESE EXTRA ADVANTAGES

CHANGE TIPS IN 6 SECONDS

No wrench needed. Fingers do the job. Just insert new tip—spin nut down—that's all.

GUARANTEED service for the rest of your life on all Smith's "LIFELONG" welding torch bodies and cutting attachments.

THINK what this means in speeding up production schedules and reducing operator fatigue! The average welder is on a stop-and-go basis most of the day—shifting to new positions or stopping to adjust his work—and thus losing production time.

This new Smith Equipment makes it possible to work in the most comfortable and convenient position because the tip can be turned in any direction even while flame is burning. No time out to shut off flame, adjust tip angle or move your work. Just a twist of the finger, or a tap on the side of the tip does the job. It's a time-saver to help you increase production per man-hour and meet production schedules.

NOTE: This feature plus high speed change of tips (in 6 seconds—no wrench needed) is available in the following Smith equipment: Smith's "LIFELONG," MIDLINE and AIRLINE Torches

MAIL COUPON TODAY FOR DETAILS

SMITH WELDING EQUIPMENT CORPORATION
Manufacturers of fine Welding Equipment for over 40 Years

SMITH WELDING EQUIPMENT CORP.
2635 S.E. 4th, Minneapolis, Minn.

Please send me more information on the time-saving and money-saving features of your new torch.

Name_____

Address_____

City_____ State_____

Ted Jefferson Honored by Milwaukee Engineering School

T. B. JEFFERSON, editor of THE WELDING ENGINEER and THE WELDING ENCYCLOPEDIA, has been appointed to the advisory committee of the Welding Institute at the Milwaukee School of Engineering, according to Karl O. Werwath, president of the school.

Mr. Jefferson holds a graduate degree from the University of Kansas and has been closely associated with the structural steel, metal fabricating and welding industries for many years. He was assistant plant engineer on the Fort Peck Dam project in Montana. Later he went to Washington, D. C., as a welding engineer in the office of the Chief of Engineers, U. S. Army, where he had charge of the design of welded dredging equipment.

He was appointed chief editor of THE WELDING ENGINEER in 1940. He is a national director of the American Welding Society, a registered professional engineer for the State of Illinois and a member of the Skokie, Ill., school board.

* * *

Precision Welder Appoints New Representatives

THREE recently designated sales representatives for Precision Welder and Machine Co., Cincinnati, O., are in Cambridge, Hartford and Newark. They are: Interstate Welding Supply Co., 37 Hurley St., Cambridge, Mass., to cover eastern Massachusetts and Rhode Island; Arcos Corp., Hartford, Conn., to cover Connecticut and western Massachusetts; Welding Sales Corporation, Newark, N. J., to cover northern New Jersey and Metropolitan New York.

* * *

Swedish Welder Manufacturer Seeks United States Agent

AB EL & Gassvetsning, P. O. Box 12018, Göteborg, Sweden, wishes to export and seeks agent for first-class gas and electric welding equipment. Illustrated leaflets and catalog are available on a loan basis from the Commercial Intelligence Branch, U. S. Dept. of Commerce, Washington 25, D. C.

* * *

New Welding Dealer

JOHN H. Druffel, Jr., Ada Neuzel and William Kite have incorporated Spacarb of Cincinnati, Inc., Cincinnati, O. The firm will distribute and maintain welding equipment, supplies and accessories.

What are you welding today, Joe?

"DIESEL FRAMES . . . and faster than ever with G-E W-32 ELECTRODES"

Copyright 1950, General Electric Company

NOW . . . With W-32, a low-hydrogen type electrode, you'll find it easy to weld "problem" steels—high-carbon, high-sulphur, steels of high hardenability which are susceptible to weld cracking, manganese steels, and steels to be enameled after welding.

Your G-E Welding Distributor maintains a stock of G-E electrode types to fit any welding job. Try W-32—see how it can save *you* money. If you'd like more information on W-32, ask him for a copy of GEA-4877. Or for information, write: *Apparatus Department, General Electric Co., Schenectady 5, N. Y.*

Using a-c or reverse polarity d-c, this all-position rod (AWS E6016) gives you:

- **Wide range of applications**
- **High impact strength and ductility**
- **High speed**
- **Greater crack restraint in high-carbon and hardenable low-alloy steels.**
- **Reduction of porosity in welding sulphur-bearing steels.**
- **Superior mechanical properties over conventionally coated types.**

ARC WELDERS • ELECTRODES • ACCESSORIES • RENEWAL PARTS

GENERAL ELECTRIC

Welding High Tensile Steels
with the NEW TENSILEND 70
LOW HYDROGEN ELECTRODE

It is made with stainless type coating, developed by Arcos, which **minimizes the amount of hydrogen** in the arc atmosphere. This control of hydrogen means

- No Underbead Cracking
- No Preheat

Tensilend 70 can be used for welding the widest range of high strength, low alloy steels. It has proved most effective in achieving sound welds with superior physicals — high ductility and impact strength.

ARCOS CORPORATION
1500 South 50th St., Philadelphia 43, Pa.

The ABC'S of Welding High Tensile Steels

Write for "The ABC's of Welding High Tensile Steels" for helpful, technically accurate, but easy-to-read information that shows the way to better welding results.

WELD WITH ARCOS

Specialists in Stainless, Low Alloy and Non-Ferrous Electrodes

Chicago NWSA Meeting Largest in History

GREATEST attendance ever recorded at a zone meeting was reached for the National Welding Supply Association meeting on Oct. 26 at the Hotel Congress, Chicago. Present were 106 distributors and manufacturers from all over the midwest. National NWSA President, Glenn G. Garman, Purity Cylinder Gases, Inc., Grand Rapids, Mich., presided.

President Garman opened the meeting with a talk on the advantages of belonging to such trade associations as the NWSA. W. F. Stewart, vice-president, Scott-Tarbell, Inc., Cleveland, led an informal discussion on what distributors consider essential in manufacturers' catalogs, price sheets, sales manuals, advertising and direct mail literature.

George C. Payne, regional director of the Department of Commerce in Chicago, told how the National Production Authority will operate, commented on various regulations issued to date and answered questions about the NPA at the close of his talk.

R. J. Farr, Welding Sales and Engineering Co., Detroit, led off the afternoon session with an explanation of his firm's participation in the NWSA's annual overhead expense report. He emphasized the value to all welding distributors in this report. Harry Johnson, manager and secretary of the Wayne Welding Supply Co., Fort Wayne, Ind., discussed the possibilities for profit in renting welding equipment and how to set up a rental department.

James N. Alcock, Saginaw Welding Supply Co., Saginaw, Mich., gave a number of practical ideas for merchandising welding equipment. The final speaker, R. J. Koltes, president, Red Arrow Sales Corp., Madison, Wis., discussed ways his firm uses to control its inventory for efficiency and ease of handling.

* * *

Heat Treating of Iron Told in Booklet

BASIC theoretical and practical principles involved in the heat treatment of iron and steel are explained in a new 33-page booklet released by the Bureau of Standards. Subjects presented include properties of iron, alloys of iron and carbon, decomposition of austenite, heat treatment of iron and steel, nomenclature of steels, etc. References, graphs, tables and photos accompany the text.

To obtain a copy, write for Circular 495, *Heat Treatment and Properties of Iron and Steel* to the Government Printing Office, Washington 25, D. C., and enclose 25c.

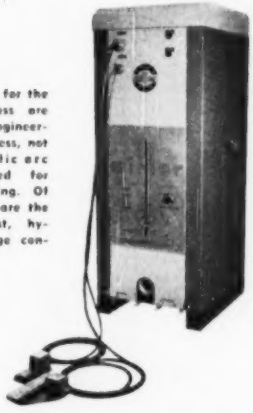
miller

WELDERS FOR BETTER WELDING AT LOWER COST!

For better welding — at low cost, select from MILLER's complete line of arc and spot welders, the dependable, field-tested model that fits your needs.

MILLER-built welders are constructed of top quality materials by skilled craftsmen. They are designed and engineered for long, trouble-free service. Satisfied users of MILLER welders throughout the world are today obtaining clean, fast welds with a minimum of maintenance cost and down time.

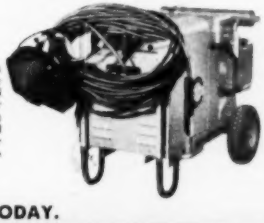
Regardless whether your requirements call for inert-arc welders, heavy duty or intermittent duty industrial arc welders, engine-driven arc welders for field use, or portable or stationary spot welders, your MILLER distributor can provide the model that will give you better welding — at lower cost. If the nearest MILLER distributor is not known to you, write the MILLER plant for his name and address. Do it today.



MILLER welders for the "Heliarc" process are designed and engineered for this process, not merely metallic arc welders adapted for "Heliarc" welding. Of special interest are the units with fast, hydraulic amperage control.

MILLER industrial welders are available in price ranges and amperage ranges to fit every requirement. The Model 88 illustrated is especially desirable in that it provides a welding current range of from 20 to 300 amperes at an extremely low cost. Other industrial welders with amperage ranges up to 1875 amps. are available.

MILLER portable spot welders are as handy to use as an electric drill or any other portable electric tool. The Model MSW and the Model LMSW-52 are available as portable units only. The 10 and 20 KVA models are designed for heavier production spot welding and are available in either portable or stationary models. Due to the design enormous capacities are obtained at low KVA input.



An extremely popular MILLER model is the AEA-200-L. As a welder, the machine will deliver a full 200 amperes of welding current. The machine can be converted to a 3 KW A.C. power plant merely by throwing a conveniently located switch. A Welder-Power Plant Combination all in one compact unit.

SEE YOUR NEAREST miller DISTRIBUTOR TODAY.

miller ELECTRIC MANUFACTURING CO.

APPLETON, WISCONSIN

REGO

HIGH PRESSURE
CYLINDER
VALVES

for OXYGEN and HYDROGEN

Designed, tested and proved for high pressures and severe service.

Packing may be replaced with cylinder under pressure if necessary.

Fuse plug and bursting disc provide positive safeguard.

Bronze stem furnished as standard, also available with monel stem on special order.

for ACETYLENE

Cadmium-plated steel stem with monel tip resists rust and wear.

Ball-nose seat construction assures positive shut-off.

for CARBON DIOXIDE

Available with diaphragm-type or packed-type construction.

Compact rugged design for use with high pressures.

Equipped with bursting disc safety device.

*Reg. U. S. Pat. Off.

The BASTIAN-BLESSING Co.
4201 West Peterson Ave. Chicago 30, Illinois

PIONEER AND LEADER IN THE DESIGN AND MANUFACTURE OF PRECISION EQUIPMENT FOR USING AND CONTROLLING HIGH PRESSURE GASES

Here's the Lowdown on the Defense Production Act

WHAT CAN President Truman do to affect private industry under the powers of the Defense Production Act of 1950, approved by Congress on Sept. 1? A summary of the act from the McGraw-Hill Washington news bureau reveals that the President is winding up with pretty much the economic powers of World War II. He now has power to channel materials and plants into essential production, to expand productive capacity, to control prices and wages and consumer credit. Price, wage and credit control powers will expire June 30, 1951, but other controls put on before June 30 would remain in effect until June 30, 1952.

Manufacturers can be ordered to accept defense contracts and to put them ahead of all other business. Truman can force conversion to military production if there's any balking on defense orders. He can control all materials. He can order cutbacks in non-military production and if need be force a shutdown of "non-essential" production. He can limit inventories, a power that may be used to prevent hoarding or excessive stocking up. He can order consumer rationing. He can finance to expand production, either through the Reconstruction Finance Corporation or through any other agency.

Wage and price control can be attempted on a voluntary basis, under the act. The President is given the authority to seek industry-labor agreements to hold the line on prices and wages, and he can suspend the antitrust laws to make such agreements possible. If voluntary stabilization does not prove adequate, however, the President also has authority to order price and wage ceilings, either on a selective basis or blanketing everything.

* * *

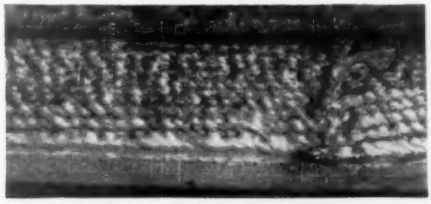
Start Lab at M.I.T. for Metal Processing

BUILDING has begun on the A. P. Sloan Metal Processing Laboratory at Massachusetts Institute of Technology. It will be completed in 1951. This new metal laboratory is provided by a gift of $1,000,000 from Alfred P. Sloan, Jr., chairman of the board of General Motors Corporation.

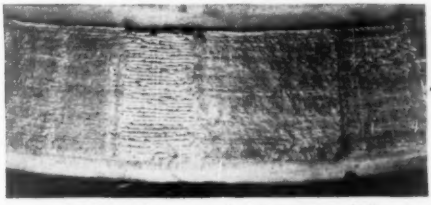
First two floors of the building will be devoted to instruction and research in machine tool operations. The third floor will have metal working and powder metallurgy equipment. The fourth and top floor will have a foundry and welding laboratory.

BLAST FURNACE UNIT SHOWS NO WEAR

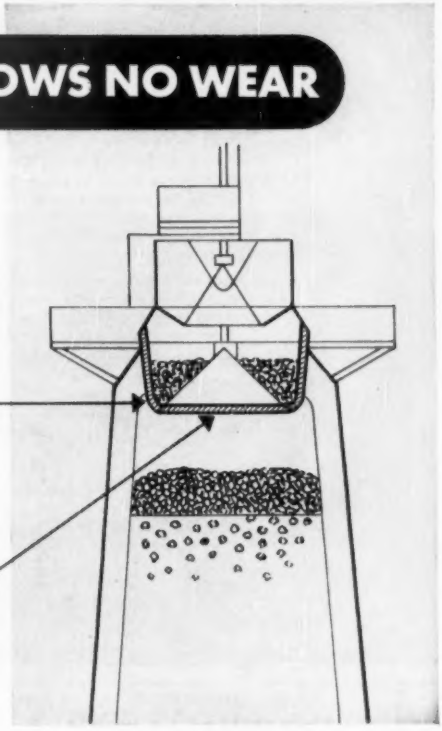
because both BELL and HOPPER were hard-faced with "HASTELLOY" alloy C



Close-up view of hard-faced surface of hopper.



Section of HASTELLOY alloy C deposit on bell.



After a year's service in a top-pressure blast furnace, the HASTELLOY alloy C surfaces on this bell and hopper unit show no signs of pitting, erosion, or wear. The unit resists the abrasive action of various charge materials and the effects of the 250 to 400 deg. F. top temperature.

HASTELLOY alloy C stays hard at the operating temperatures, and deposits made with this alloy maintain their resistance to checking and chipping. Surface hardness can be increased to as much as 400 Brinell by simple cold-working.

Alloy C has already increased the life of other types of steel plant equipment 10 times or more in such applications as blooming-mill hot shear blades, entry guides, twist guide rolls, angular-type guides, and dies and shafts. In these applications, as with the bell and hopper unit, hard-facing results in fewer shutdowns, less replacements, and greatly reduced maintenance costs.

Write for the booklet, "New Hard-Facing Techniques for Protecting Steel Mill Equipment from Wear." It describes some of the many hard-facing jobs that have resulted in large savings through use of HASTELLOY alloy C. In addition to HASTELLOY alloy C, there are many other HAYNES hard-facing rods—for practically every condition of wear, heat, impact, or severe abrasion. For information about any particular application that you may have in mind, contact the nearest Haynes Stellite District Office. Our engineers will be glad to help you.

HAYNES TRADE-MARK *alloys*

Haynes Stellite Division
Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago — Cleveland — Detroit — Houston
Los Angeles — New York — San Francisco — Tulsa

"Haynes," "Haynes Stellite," and "Hastelloy" are trade-marks of Union Carbide and Carbon Corporation.

SAVE TACKING TIME!
Quick-acting, positive Danly KWIK KLAMPS hold pieces firmly in place for welding . . . clamping pressures up to 750 pounds maintain precision alignment. A single motion of the lever handle clamps or releases the work, saving precious production hours.
Available in 26 sizes and a wide variety of designs, KWIK KLAMPS suit almost every application. Select the style and size for your use from the booklet illustrated below.
SEND FOR YOUR KWIK KLAMP BOOKLET TODAY!
DANLY
DANLY MACHINE SPECIALTIES, INC.
2100 South Laramie Avenue, Chicago 50, Illinois
PRECISION DIE SETS . . . TOOL, DIE AND GAGE MAKERS' SUPPLIES

IMPORTANT

NEW USES

MEAN THAT YOU CAN

SAVE MONEY

WITH

3 in 1 "York's 77" SPECIAL FLUX

FOR . . .

GENERAL BRAZING

CAST IRON WELDING

CAST IRON BRAZING

NO NEED TO STOCK 3 DIFFERENT FLUXES WHICH DETERIORATE WHEN ONE CAN OF

"York's 77" 3 in 1 FLUX

MEETS ALL YOUR NEEDS

Make full use of the 4 famous features of "York's 77".

You will save money, save labor, and save time.

1 Fear of overheating can be forgotten.

2 Cleaning and grinding are unnecessary, because "York's 77" penetrates through grease, oxides, etc.

3 Chipping is unnecessary, because a satisfactory bond can be obtained on oxidized surfaces.

4 Deteriorated cast iron can always be welded successfully with "York's 77".

YORK ENGINEERING COMPANY

3349 OGDEN AVE. • CHICAGO 23, ILL.

Arc Welded Tower in Australian Refinery

AN 80-ft re-run (bubble) tower, largest of three stills in the distillation unit of the new Vacuum Oil Company Refinery at Altona, Victoria, is all arc-welded. The main shell of the 33-ton tower, with a diameter of 5 ft and a length of 57 ft, consists of 9/16-in. plate with a flanged dished head formed from 11/16-in. plate. This section is mounted on two smaller sections of 3 ft diameter, 16 ft long and 18-in. diameter, 5 ft long.

Boiler-quality mild-steel plate was used throughout. For both circumferential and longitudinal butt welds, a double 70-deg vee preparation was made. Inspection manholes were butt-welded to the shell, and a compensating flange made from 5/8-in. plate was welded to the manholes and shell.

—*McGraw-Hill World News*

* * *

Reconditioning Gloves Saves One Plant 80%

U. S. Industrial Glove Corporation, Detroit, has started reconditioning service that includes renovation, sanitizing and packaging of all types of wornout fabric and leather gloves and protective clothing. The service has proved successful in automotive, glass, welding, electrical and office machine plants. One large customer saved 80% of all gloves sent in for salvage.

Some gloves may be salvaged several times, it has been found. Oddly enough, some workers prefer reconditioned gloves to new ones because of their greater pliability and comfort.

* * *

"In case of power failure . . ."

Mallory 22 Welding Wheels

Take Hot And Tough Jobs In Their Stride!

Forged wheels of Mallory 22 Metal are setting an amazing new pace for seam welding applications requiring high operating pressures and temperatures . . . those jobs where cracking and mushrooming normally take a high toll in wheel life.

Typical is the outstanding record made by one Mallory customer in the roll spot welding of automobile frames. Previously, 830,800 spots per wheel was considered good. Mallory 22 was recommended to the customer . . . and now his production, using Mallory 22 forged wheels, is running at 1,513,296 spots per wheel . . . making a far lower cost per weld.

That's value beyond the purchase!

Mallory's resistance welding know-how is at your disposal. What Mallory has done for others can be done for you!

In Canada, made and sold by Johnson Matthey & Mallory, Ltd., 110 Industry St., Toronto 15, Ontario

MALLORY 22 METAL

Mallory 22 is a high-strength, high-conductivity copper base alloy containing cadmium and zirconium. It is covered by Mallory-owned U. S. Pat. 2086329. Mallory 22 has been found to give outstanding results when used as seam welding wheels on light gauge steels, as well as the welding of coated steels, such as terne plate, galvanized iron, etc.

Resistance Welding Tips, Holders, Dies, Rod and Bars, Castings, Forgings

SERVING INDUSTRY WITH

Capacitors	Contacts
Controls	Resistors
Rectifiers	Vibrators
Special Switches	Power Supplies

Resistance Welding Materials

P.R. MALLORY & CO. Inc.

MALLORY

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Now! Welding Plates With Inspection Window Package

Today, business—your business—demands efficient time-saving methods. The Sellstrom Welding Plate package with the inspection window permits instant inspection for density without opening the package.

Each Sellstrom Welding Plate is in an individual package. The density shade (2 to 16) is stamped on the package. The correctness of the numbering is instantly proved by actually being able to see the degree of density of the plate through the cut-out inspection window. It is not necessary to open the package. You can actually inspect the plate density as easily as if there were no package.

Each package contains a three-piece Welding Plate: (a) the welding lens, (b) the gasket, and (c) the clear glass cover lens.

Your dealer can supply you. If you like, you can ask us to mail you a sample of this new package with the inspection window.

See Complete Details in Catalog No. 27

Sellstrom Welding Plates are available in nine different styles, each for a special purpose, as described on page 19 in our catalog.

If you do not have this late catalog, or have mislaid yours, we will gladly mail you another copy on request. If you would like to inspect the new package, ask us to mail you a sample.

sellstrom

MANUFACTURING COMPANY

More Than 200 Eye and Face Safeguards

626-L N. Aberdeen St. Chicago 22, Ill.

Pipe Welding Film Available for Schools

NEW color and sound movie, "Underground Highway," is available for showings from the Texas Gas Transmission Corp., Owensboro, Ky. It covers construction of the corporation's new $73,500,000 natural gas pipe line project and shows many beautiful scenes from the "Big River Region" (an area extending from Arkansas and Mississippi to Kentucky and Indiana in the North).

Prints of the film are available to schools, clubs and other organizations without charge except for shipping costs.

* * *

7 Miles of Welded Piping Will Heat New Church

NEARLY seven miles of 1½-in. wrought-iron piping for radiant heating were installed under the floor of the "House of God," a non-denominational church at Mooseheart, Ill. The piping will carry hot water through floor panels. All of it was installed by oxyacetylene welding.

* * *

Lapeer Moves Sales Office

LAPEER MFG. CO., manufacturers of toggle-action clamps, has moved its sales offices to 1144 West Baltimore, Detroit 2. Manufacturing continues at the plant in Lapeer, Mich.

* * *

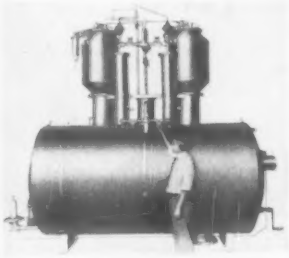
Book Reviews

KENT'S MECHANICAL ENGINEERING HANDBOOK, 12th edition, Volume 1, Design and Production. Edited by Colin Carmichael. Published by John Wiley and Sons, Inc., New York, 1950. Simulated leather, 8½ x 5½ in., 1660 pages. Price $8.50.

Since 1895 Kent's has been tops in mechanical engineering reference books so there is little need for an elaborate review.

This volume, nearly completely rewritten, is more than 300 pages larger than the previous edition. It is divided into 28 sections, which may be classified broadly into selections of materials (section 1 to 6); design principles (section 7 to 9); design and selection of machine components (section 10 to 18); production processes (section 19 to 25); production plant equipment (section 26 to 27); and mathematical tables (section 28). References in the text and at the ends of chapters guide the readers to sources of more detailed information.

FOR BIG PRODUCTION OF ACETYLENE AT AN AMAZINGLY LOW COST



Sight Feed

MODEL A-TWIN

CONTINUOUS FLOW

ACETYLENE GENERATOR

- Here's ECONOMY in capital letters. Produce your own acetylene at a savings of 50% or more of the cost of cylinder acetylene.
- No shutting down for re-charging. The Model A-Twin automatically produces a continuous flow of the purest, hottest acetylene obtainable. Simple in operation.
- Manufactured in five sizes, producing from 500 to 2,400 cu. ft. of acetylene per hour.

See your Distributor or write for full information. Also, ask about

SIGHT FEED ACETYLENE FILLING PLANTS

COMPLETE IN EVERY DETAIL.

THE SIGHT FEED GENERATOR COMPANY

West Alexandria, Ohio, U. S. A.

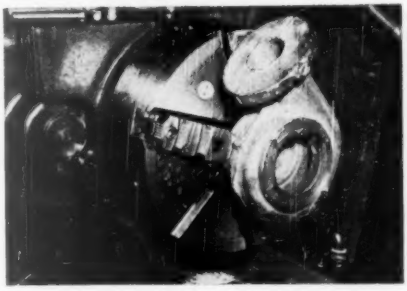
WHEN WELDS MUST BE MACHINABLE

1. The 45-pound iron pump casing shown above was defective as cast. Part of the intake flange was missing. A bad blowhole had all but destroyed an important boss.

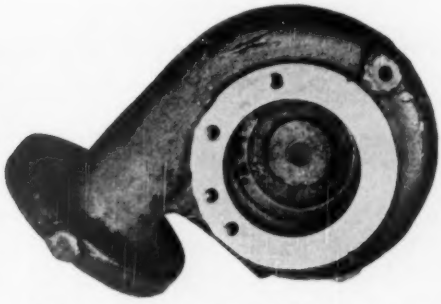
In many foundries the casting would have been scrapped, a red-ink entry on the day's production ledger. But not at this busy foundry!

2. The bad casting was sent to the welding shop with orders to repair if possible. And . . . thanks to NI-ROD . . . it was possible!

Defective areas were chipped out with a cold chisel and filled with five weld layers, two beads per layer. Each bead was wire-brushed before laying down the next deposit. 5/32 in. NI-ROD was used.



3. The welded flange face was turned down at 185 ft. per min., using a carbide cutting tool with .117-in. feed. The flange bore was machined at the same speed, using a tool steel cutter and .012-in. feed.



4. After machining, bolt holes were drilled and tapped in the weld, fusion zone and cast metal. Although there was a thin area of hardness at the surface near the line of fusion, no difficulty was encountered during any of the finishing operations.

Thanks to Ni-Rod's® dependability and ease of handling, the repair of defective iron castings is standard practice in many of the nation's busiest foundries.

Ni-Rod makes sound welds—*machinable* welds—with a minimum of preparation. Preheating and postheating are seldom required. Ni-Rod works well in all positions, giving good wash and easy slag removal. It is stable-arcing on both AC and DC currents.

Another advantage—Ni-Rod deposits are a good color match for gray iron.

Ni-Rod is produced in four diameters: 3/32", 1/8", 5/32" and 3/16". Your nearest Inco distributor will gladly give you full information about Ni-Rod and other Inco welding materials.

Write to Inco for your copy of "NI-ROD . . . AN ELECTRODE FOR ANY CAST IRON WELDING."

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An Unbeatable Combination!

SILVALOY SILVER BRAZING ALLOYS

The Silvaloy group consists of 7 popular silver brazing alloys high in tensile strength and producing strong, ductile joints on ferrous and non-ferrous metals.

	SILVER CONTENT	MELTING POINT	FLOW POINT
SILVALOY 50	50%	1160 F	1175 F
SILVALOY 45	45%	1125 F	1145 F
SILVALOY 40	40%	1135 F	1205 F
SILVALOY 35	35%	1125 F	1295 F
SILVALOY 20	20%	1430 F	1500 F
SILVALOY 15	15%	1185 F	1280 F
SILVALOY 503	50%	1195 F	1270 F

1200 All-Purpose Flux—for use on all metals. No. 1200 Flux readily dissolves oxides during brazing operations and aids in the flowing of the alloy. Meets all government specifications.

1100 Low Temperature Flux—superior where exceptionally clean surfaces on copper or copper alloys are required at lower temperatures.

COMPLETE STOCKS

Oxy-acetelyne welding rods and flux for cast iron, steel, aluminum, brass, copper, bronze, nickel, monel and inconel.

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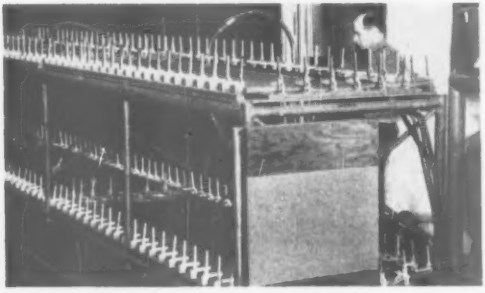
BRANCH PLANTS: Detroit, St. Louis • **BRANCH OFFICES:** Milwaukee, Minneapolis, Grand Rapids, Indianapolis, Kansas City, Mo.



Another Battery of KNU-VISE CLAMPS to expedite production of hundreds of B-36 parts

Knu-vise clamps are installed on this special table fixture in Consolidated Vultee's San Diego plant to provide an air-tight seal around a rubber blanket. Beneath the blanket are parts for B-36 bombers which are joined by Metlbond (a metal adhesive) instead of rivets. The fixture is moved into a furnace where heat and pressure are applied.

The quick acting clamps expedite production of hundreds of B-36 parts—the clamps can be secured and unlocked in a fraction of the time required if screws were used.

Approximately 800 Knu-vise clamps are installed on fixtures in Convair's Metlbond assembly department. On this fixture, the clamps are spaced at 5-inch intervals.

Sales Representatives in Principal Cities
Send for Complete Catalog

KNU-VISE PRODUCTS **LAPEER MANUFACTURING CO.**
3056 DAVISON ROAD • LAPEER, MICHIGAN

Western Division, 422 Magnolia Street, Glendale, California
Canadian Stocking Distributor: Higginson Engr. Sales, P.O. Box 23, Hamilton, Ontario

Metal & Thermit Names Four New Distributors

THREE distributors in this country and one in Hawaii were recently named to handle the complete Metal & Thermit lines of electrodes, welders and welding accessories. They are: Hampden Oxygen & Acetylene Supply, Holyoke, Mass.; Beaver Welding Supply Co., Memphis, Tenn.; Franklin Supply Co., Columbus, O. and George M. Glover & Co., Honolulu, T. H.

* * *

30 YEARS AGO

(From THE WELDING ENGINEER of Dec., 1920)

VOCATIONAL welding is being taught by the Army at Camp Pike, Ark. The course lasts six months and covers everything from the construction of acetylene generators to the maintenance of Army equipment at the camp. The Army hopes that such schools will improve the quality of its organization and also prepare soldier for return to civilian life.

—30 YEARS AGO—

OXYACETYLENE welded joints on the new Butte, Montana, water pipeline make it unique among such projects. Part of the pipeline is wooden, being redwood staves. The rest is ⅛-in. thick pipe of 24 and 26-in. diameter. The reason for welding the pipeline was that it allowed a much lighter wall thickness of pipe than for equivalent capacity riveted pipe.

—30 YEARS AGO—

THE Oxweld Acetylene Company has established a Pacific Coast office at San Francisco.

—30 YEARS AGO—

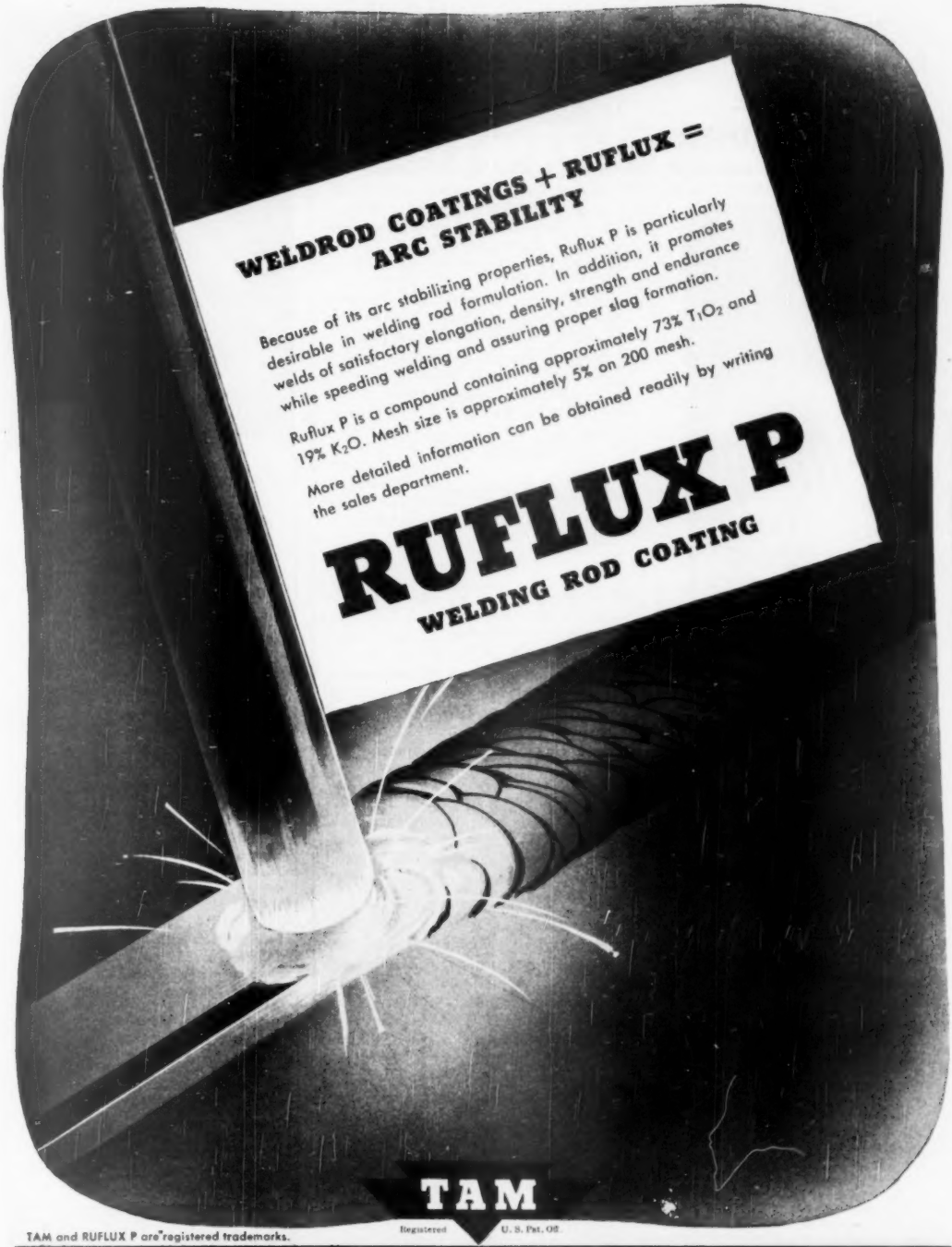
ADDITION of 3% pure manganese to regular Thermit welding mixture increases the life of Thermit-welded wobblers, pinions, rolls and shafts in the steel mills, according to Metal & Thermit Corp.

—30 YEARS AGO—

NEW method for testing the ductility and tensile strength of welds has been developed at the Norfolk Navy Yard. It consists of cutting a ring-shaped specimen from the metal to be tested and bursting the specimen in a specially designed apparatus.

—30 YEARS AGO—

AN ALL arc-welded towing target for the practice firing of battleships was recently built at Norfolk Navy Yard. It was 172 ft long. Savings of $4,500 are realized on such welded targets.


WELDROD COATINGS + RUFLUX =
ARC STABILITY
Because of its arc stabilizing properties, Ruflux P is particularly desirable in welding rod formulation. In addition, it promotes welds of satisfactory elongation, density, strength and endurance while speeding welding and assuring proper slag formation.
Ruflux P is a compound containing approximately 73% TiO_2 and 19% K_2O. Mesh size is approximately 5% on 200 mesh.
More detailed information can be obtained readily by writing the sales department.
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WELDING ROD COATING
TAM
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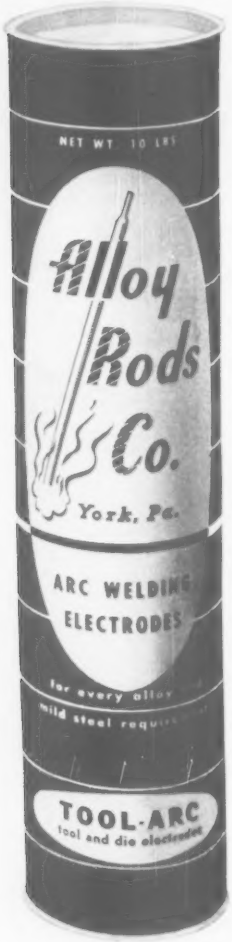
STEEL CONTAINER

Moisture, dirt and grease proof . . . Easy to stock convenient 10 lb. size.



TOOL-ARC TOOL AND DIE ELECTRODES

TOOL-ARC saves you money repairing or reclaiming expensive tools and dies . . . saves production delays too. Here's a complete line of electrodes for welding each of the 6 basic types of tool and die steels. Recommended procedures and heat treatments are described in Bulletin No. 2519. Alloy Rods Company, York, Penna.

About People

F. E. GARRIOTT has been named manager of the weld rod and wire department of Ampco Metal, Inc., Milwaukee. He was previously product manager of the department.

* * *

EDWARD A. LIVINGSTONE, vice-president in charge of sales of The Babcock & Wilcox Tube Company at Beaver Falls, Pa., has been named to the Steel Products Industry Advisory Committee to advise in the administration of the Defense Production Act.

* * *

WILLIAM T. KELLY, JR., has been appointed president of American Brakeblok Division of the American Brake Shoe Co.

* * *

Following are the newly elected officers of the Reid-Avery Co., Inc., Baltimore: MARSHALL E. REID, chairman of the board; CHARLES L. VIRDEN, president; L. H. CHRISTENSEN, executive vice-president; JAMES M. SAWHILL, vice-president, engineering, and GERARD E. CLAUSSEN, vice-president, research and development.

* * *

RAYMOND C. SCHEEL and HERBERT W. SCOTT, JR., have been named field engineers in New York and New Jersey, respectively, for Nelson Stud Welding Division of Morton Gregory Corp., Lorain, O.

* * *

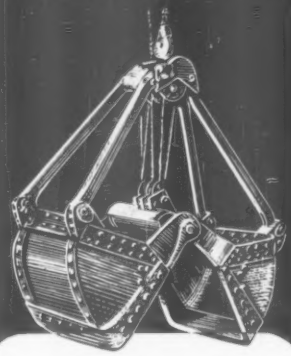
DR. IRVING LANGMUIR, recently retired associate director of the General Electric Research Laboratory, was awarded the John J. Carty Gold Medal of the National Academy of Sciences on Oct. 12. He is the recipient of many awards, including the Nobel Prize in chemistry, the Faraday Medal of the British Institute of Electrical Engineers, and the Franklin Medal of the Franklin Institute in Philadelphia.

* * *

DR. H. K. IHRIG has been elected vice-president in charge of research of the Allis-Chalmers Mfg. Co., Milwaukee. To accept this post, Dr. Ihrig resigned as vice-president and director of laboratories of the Globe Steel Tubes Co. He is a member of the American Welding Society.

AVOID NEEDLESS WASTE!

IN THESE TIMES, IT'S ESSENTIAL TO SALVAGE YOUR WORN EQUIPMENT



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CLAMSHELL BUCKETS

WITH

MANGANAL

U. S. PATENTS 1,986,738—1,947,167—2,021,945

11% - 13½% MANGANESE-NICKEL STEEL

WELDING PRODUCTS

SPEEDS REPAIRS . . . from repairing Clamshell Lips with MANGANAL Special Shape Applicator Bars and Electrodes to lining sides of worn bucket with MANGANAL Flat Applicator Bars.

SAVES TIME AND MONEY . . . Clamshell Buckets, repaired with MANGANAL, often outlast new ones!

MANGANAL is easily bent, hot or cold . . . Work hardens under impact and abrasion to 550 Brinell . . . tensile strength up to 150,000 p.s.i.

FREE—Informative literature outlining newest methods for speedy and economical repair of Buckets.

NAME OF NEAREST DISTRIBUTOR ON REQUEST

STULZ-SICKLES CO.

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GODFREY B. GRABLE has been appointed to the staff of Battelle Memorial Institute, Columbus, O., to do work in the Institute's program of welding research. He was formerly with A. O. Smith Corp., the Bureau of Ships and the Bureau of Aeronautics.

* * *

AUSTIN C. ROSS, manager of the Buffalo works of Worthington Pump and Machinery Corporation, Harrison, N. J., has been elected a vice-president of the company.

* * *

JOHN T. M. FREY has been appointed assistant manager of the New York branch of Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J. LAMAR S. HILTON is now assistant sales manager of the abrasive wheel department.

* * *

DAVID T. CORNFOOT has been named assistant to the manager for the Boston office of the Calco Chemical Division of American Cyanamid Co. W. E. SMALL has been appointed assistant to the manager for the Providence office of the division. CAMERON MACKENZIE will coordinate activities between Calco at Bound Brook, N. J., and Boston and Providence.

* * *

CHARLES A. BUTCHER has joined Worthington Pump and Machinery Corp., Harrison, N. J., as assistant to the president, H. C. RAMSEY.

* * *

M. B. GARBER has been named director of sales for The Thew Shovel Co., Lorain, O. J. T. CUSHING has been appointed sales manager.

* * *

A. D. SHEERE has been named manager of the San Francisco division of A. M. Byers Co. He succeeds P. D. TABLER, who is retiring.

* * *

WAYNE E. WILLIAMS has been appointed western district manager for Tube Turns of Canada Limited. His office is at Edmonton, Alberta.

* * *

Died . . .

LANCE NICHOLSON, 75, president-treasurer of the Nicholson & Hall Boiler & Welding Corporation and a pioneer in arc welding in the Buffalo, N. Y., area died on Oct. 31. He formed the Nicholson firm in 1922.

* * *

WILLIAM F. MUNDAY, deputy comptroller of The International Nickel Company of Canada, Ltd., died at Teaneck, N. J., Nov. 1 at the age of 54.

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ECONOMICAL

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Just Add

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Old Rocker Arm Welders

Your present rocker arm spot welders can *really* produce *extra* profits—for all it takes is the simple installation of a compact Weld-Air-Matic. This self-contained control unit *air-powers* your welder—adds *speed, accuracy, ease of operation* never before possible with your present foot-operated welder.

Tests Prove 10,000 Welds Hourly on Continuous Daily Schedules

The Weld-Air-Matic provides a feather-touch foot switch that controls pressure and energizes a coil on a four-way operating valve. Employing reduced air pressure of 15 to 50 lbs., it has a maximum stroke of 1½" on size 1 unit, 2" on size 2, and 2½" on size 3 unit. Requires any standard Weld Timer and a minimum of 4 cubic feet air supply per minute, with 80 lbs. minimum line pressure. Three sizes available with all accessories mounted to one strong aluminum alloy casting.

Get the facts now on how you can break all previous production records with your present equipment, by modernizing with the new Weld-Air-Matic. You can't lose — for the savings you make will quickly account for Weld-Air-Matic's nominal cost.

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Please send me full details on the Contour Marker.

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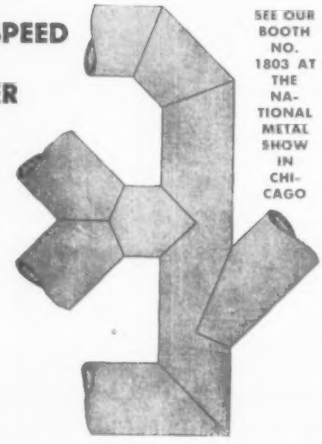
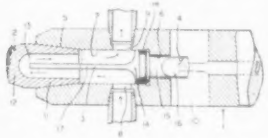


SEE OUR BOOTH NO. 1803 AT THE NATIONAL METAL SHOW IN CHICAGO

From the Patent Office

R-W Electrode Assembly

2,517,798. GLENN S. MCINTYRE, Lansing, Mich. Assigned to Kelsey-Hayes Wheel Co., Detroit. Filed May 31, 1949. Granted Aug. 8, 1950.

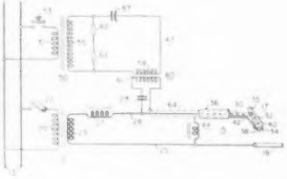


Newly patented welding electrode assembly comprises a holder formed with a recess and having inlet and outlet openings connecting to it for the passage of a cooling fluid. A detachable tip extends within the recess in electrical contact with the holder. The tip has a recess connecting to the holder recess and a solid outer end wall and a member having a partition extending substantially diametrically within and extending across the holder recess between inlet and outlet openings. Its outer end is spaced from the outer end wall. The holder tip and member cooperate to form a passage for the cooling fluid from the inlet to the outlet.

* * *

Arc Welding System

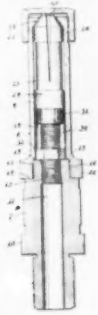
2,516,037. CLIFTON S. WILLIAMS, Pittsburgh. Assigned to Westinghouse Electric Corp., East Pittsburgh, Pa. Filed Nov. 3, 1948. Granted July 18, 1950.



Patent pertains to an arc welding system in which a main electrodes connected to a single phase source of current. A workpiece maintains an arc with the electrode. An auxiliary electrode is disposed in insulated relation with the main electrode and is connected to the current source through an impedance. This maintains an auxiliary arc between the main and auxiliary electrodes only until the arc is established between main electrode and workpiece.

Gas Welding Tip

2,517,877. ALVA K. HINCHMAN, Bryn Mawr, Pa. This application May 26, 1949. Granted Aug. 8, 1950.

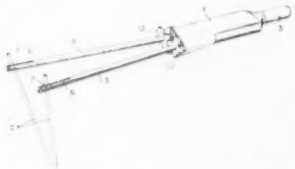


Patent covers a tip for welding that comprises a head bored through from end to end. A conical seat is on the interior of the outer end of the head. A socket is at the inner end of the head. A body section has a bore through it and is interiorly threaded at its inner end. A neck carried by the body section detachably engages the socket end of the head section. A sleeve has a conical outer end to fit the conical seat. The sleeve is slit for a distance from the outer end inwardly. A hollow adjusting member is externally threaded and is adjustably screwed into the inner end of the bore of the body section. This contacts the sleeve for pushing the latter outwardly as the sections are connected together.

* * *

Twin Carbon Electrode Holder

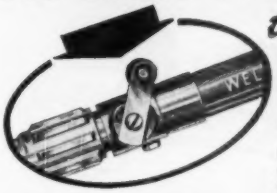
2,520,151. GEORGE G. LANDIS, South Euclid and NORMAN J. HOENIE, Cleveland Heights, O. Assigned to The Lincoln Electric Co., Cleveland. Filed May 3, 1945. Granted Aug. 29, 1950.



In a portable arc welding electrode holder there is a handle formed with a pair of spaced adjacent bores. Two members are rotatably fitted in such bores and extend from one end of the handle in spaced but adjacent relation. Electrode gripping means are provided in the outer ends of the members. Two intermeshing gears, one on each of the members, are mounted that the members may be rotated together.

for Mass Production Welding

there's no torch like the

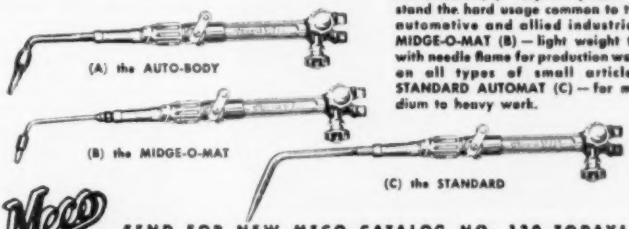


Meco AUTOMAT

The famous MECO "On-Off" Action (above) allows a tiny pilot light to burn at the tip with the action in the "off" position. At a touch it flashes to full production flame. Action tested over 200,000 times without appreciable sign of wear.

For mass production there is no such thing as a good all-round torch. Time and motion studies have proved that for efficient production welding, the torch used must be fitted to its particular job. The Meco AUTOMAT family — embodying the famous MECO "On-Off" action (oval), is perfectly suited to the start and stop welding so common to production. The importance of this time saving feature to mass production work is apparent. Beyond this, each member of this family has built-in features perfectly suiting it to its own particular class of welding.

AUTOBODY (A) — especially built to stand the hard usage common to the automotive and allied industries. MIDGE-O-MAT (B) — light weight tip with needle flame for production work on all types of small articles. STANDARD AUTOMAT (C) — for medium to heavy work.



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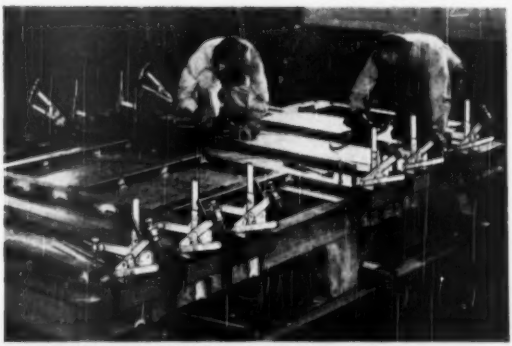

HOLD with "DE-STA-CO" clamps

Revised 32-page catalog of toggle clamps, accessories, applications. Template sheets for efficient fixture design.

Precision clamp manufacture and high holding-pressures are the "secret" of this efficient welding fixture. Locating pins welded to clamp bars hold channels in positions to weld variable length assemblies in this versatile fixture. "De-Sta-Co" reamed holes and hardened pins assure accurate positioning of parts. Positive holding pressure forces cross members and plates into close contact essential for strong production welding. And "De-Sta-Co" quick toggle action makes loading a job untrained workers, even women operators, handle with ease, in seconds.

More than forty "De-Sta-Co" models—including new portable and plunger clamps—offer quick solutions to your locating and holding problems. The "De-Sta-Co" stocking distributor in your area is qualified to assist you; call him in, or, if you haven't met him, write for his name and your copy of our catalog, today.

DETROIT STAMPING COMPANY

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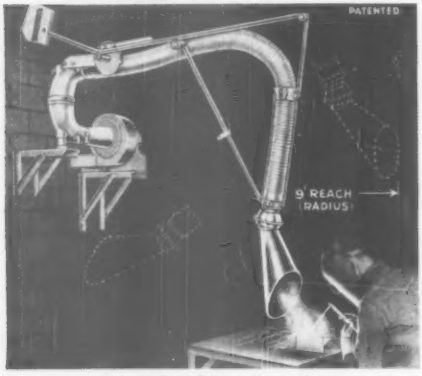

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Welding shops equipped with Ruemelin Fume Collectors are assured of a clean shop atmosphere. Noxious fumes, heat and smoke are eliminated at their source, thus improving working conditions, lessening fatigue and paving the way for increased plant production.

The Ruemelin Fume Collector hood can be instantly placed where needed anywhere in the booth welding area. No tedious adjustments necessary. Just pull the inlet hood to the welding position and you are ready to go. Approved by state industrial commissions and by compensation insurance companies. Simple to install. Thousands in service. Many users send in repeat orders. Write for bulletin 37-D today.

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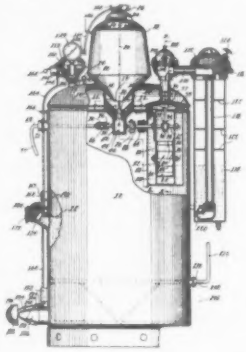
PROTECT-O-METAL No. 2
Protect steel stored out of doors as long as 2 years with
PROTECT-O-METAL No. 8

Protect-O-Metal No. 2 keeps weld spatter away from metal. After welding, spatter wipes off with a dry cloth. No wasted profits cleaning welds with air chisels, wire brushing or sand blasting. Protect-O-Metal No. 2 costs about 1/10c per foot of weld protected . . . saves up to three times its cost. Protect-O-Metal No. 8 keeps steel rust-free as long as two years under difficult storage conditions. When you are ready to weld . . . wipe dirt away and weld, no further preparation needed. Both compounds are smokeless . . . odorless . . . non-toxic. A trial gallon of either compound will be supplied for testing in your plant. Your money back if these compounds are not satisfactory.

G. W. SMITH & SONS, INC.
5408 Kemp Road, Dayton 3, Ohio

Acetylene Generator

2,515,168. DANA HAMILTON BAILEY, Delavan, Wis. Assigned to John R. R. Miles, Inc., Minneapolis, Minn. Filed April 25, 1945. Granted July 18, 1950.



Newly patented acetylene generator includes a water tank, a carbide hopper and means for feeding carbide to the tank according to the gas pressure in the tank. A blow-off valve and a drain valve with safety attachment are built on the tank. A lever pivoted to the drain valve is held by a spring to a fixed position. A safety rod prevents movement of the lever because of its spring. The safety rod is connected to the blow-off valve to prevent its closing except when the drain valve has been moved to an open position. The drain valve when in open position engages the lever to move it against its spring, which then permits the safety rod to move by closure of the blow-off valve.

* * *

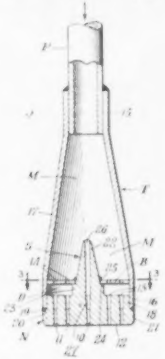
Cutting Torch Tip

2,514,777. DANIEL A. MARRA, Chesswick, Pa. Filed July 25, 1947. Granted July 11, 1950.

Recently patented torch tip comprises an inner tubular shape whose body at the delivery end of the tip is formed of a highly refractory metal. This end of the tube is externally formed with a number of lengthwise grooves. An intermediate member shorter than the inner member overlies the grooved part of the inner member. It forms with the grooves gas passageways. An outer tubular member, formed of less refractory material, is telescopically assembled with the inner and intermediate members and forms with them a gas chamber.

Multi-Flame Torch

2,518,544. CLIFFORD C. ANTHES, Union, N.J. Assigned to The Linde Air Products Co. Filed Nov. 15, 1947. Granted Aug. 15, 1950.



Newly patented torch includes a tube enclosing two gas chambers. A nozzle has its outside secured gas-tightly to the front end of the tube and provides a wall of the second gas chamber. The nozzle has a group of gas discharge ports leading from the second gas chamber to the atmosphere and a central gas discharge port opening into the atmosphere. A baffle provides a wall between and common to both chambers. The baffle has ports extending through it to connect the chambers. A boss is secured to the nozzle and extends back through the second chamber rearward of the baffle and into the first chamber. The boss coöperates with the tube to provide an annular gas chamber next to and upstream of the connecting ports in the baffle. The boss has a gas passageway extending through it and connecting to the central gas discharge port in the nozzle. The passageway has a gas inlet in the first chamber upstream of the annular chamber.

* * *

Weld Sealing Compound

2,510,727. PAUL SUSENBACH. St. Louis, Mo. Assigned to The Presstite Engineering Co., St. Louis. Filed May 15, 1946. Granted June 6, 1950.

Recently patented compound for sealing spot welded seams consists of 35 to 60% of a tacky, adhesive plastic resin bonding material of the alkyd resin and polybutene group. It also has 0 to 35% pigment, 5 to 25% shredded chrysotile, 1 to 20% of finely divided electrical conducting material, 2 to 20% of an organic polar solvent for increasing plasticity and reducing the electrical resistance of the composition and from 0 to 15% of a diluent for increasing the initial plasticity of the compound.

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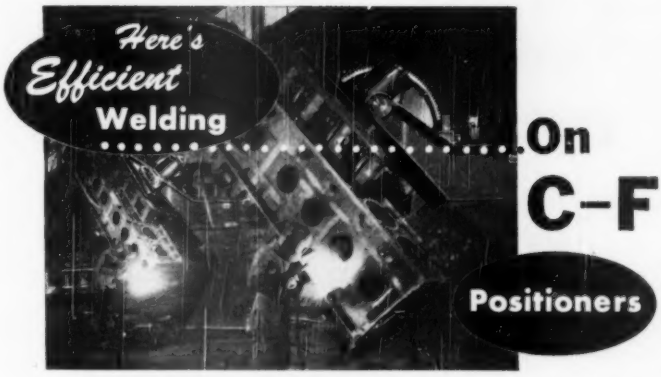

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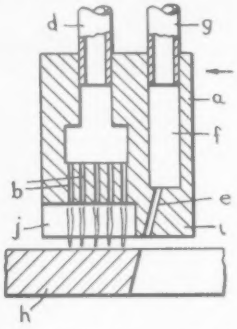
Flame-Cutting Tip

2,517,641. CEDRIC DOD, Giffnock, Scotland. Filed Feb. 13, 1947. Granted Aug. 8, 1950.



Patent covers an oxygen jet cutting tip that has heating and cutting gas chambers, each in communication with a gas supply source. Base of the nozzle is perforated to provide a series of heat gas discharge passages aligned in a single plane. The inner ends of the passages connect to the heating gas chamber. The outer ends of the passages open through the base surface. A separate passage is a cutting gas discharge passage connecting to the oxygen source at the inner end and at the outer end opening through the base in back of the heating gas passages. The cutting gas passage is also in the vertical plane, but is aligned downwardly and forwardly toward the heating gas passages. It is out of vertical with the work when the nozzle is in cutting position. The part of the base in which the heating gas passages discharge is recessed upwardly to provide screening means for them.

* * *

Inert-Arc Welding System

2,517,739. JOSEPH M. TYRNER, New York City, and NELSON E. ANDERSON, Scotch Plains, N. J. Assigned to Air Reduction Co., Inc., New York City. Filed March 2, 1948. Granted Aug. 8, 1950.

Patent covers an inert-gas-shielded arc welding system including a manual water-cooled electrode holder, a water circulating system, a welding circuit, a water control valve on the electrode holder's handle and a flow-responsive switch in the water circulating system. Said switch has a pair of electrical contacts that control it. When the weldor closes the water-control valve sufficiently to reduce water flow, the switch moves to one position and to another when he opens the water-control valve. An electric relay is connected to the contacts.

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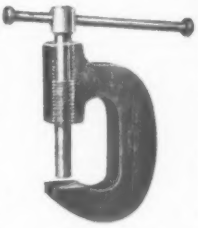

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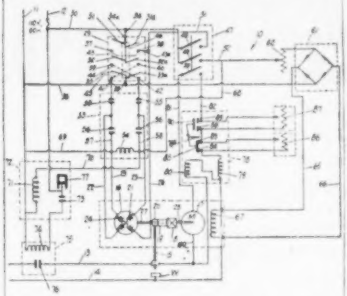
Automatic-Welding Control

2,516,777. FLOYD C. KNIGHT and ELLIOTT C. CORNELL, JR., East Cleveland, O. Assigned to the Auto Arc-Weld Mfg. Co., Cleveland. Filed July 28, 1947. Granted July 25, 1950.



Patent covers an automatic welding head control having a d-c motor with a separately excited field. The armature of the motor is connected in parallel to the welding arc. A relay has an operating coil connected in series with the motor and a second coil in parallel to the arc, the parallel coil being adapted to hold in the relay until a welding arc is struck. A high and a low resistance are connected to the relay. This relay is adapted to change the armature circuit to insert the high resistance in the armature circuit when starting the motor. The relay changes its position to remove the high resistance from the armature circuit substantially simultaneously with the establishment of a welding arc.

* * *

Flux for High-Nickel Alloys

2,518,366. GEORGE RAYMOND PEASE, Plainfield, N. J. Assigned to The International Nickel Co., Inc., New York City. Filed July 1, 1948. Granted Aug. 8, 1950.

Patent pertains to a welding flux substantially free of substances producing deleterious hot cracking while welding high-nickel alloys. It consists of the following chemicals by percentage weight: sodium fluoride, 15%; calcium fluoride, 10 to 40%; barium fluoride, 40 to 70%; barium chloride, 10 to 20%, and a water-dispersible binder of gum arabic from 2 to 10%.

* * *

Arc Welding Electrode

2,520,112. PHILIP BOURQUE and MATT KHLUNEN, Detroit. Filed April 24, 1948. Granted Aug. 29, 1950.

Patent covers an arc welding electrode having an elongated hollow body. A number of welding electrodes are positioned about the body.

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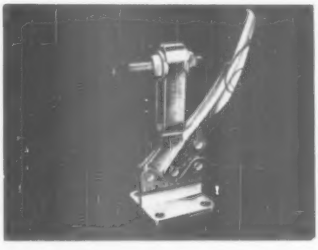

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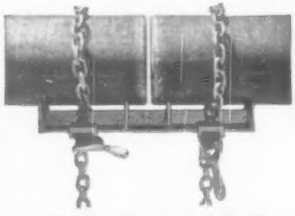

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500 AMPS for 3/8–3/32" rod	300 AMPS for 1/4–1/16" rod	250 AMPS for 3/16–1/16" rod	200 AMPS for 5/32–1/16" rod
$6.50	$5.00	$4.75	$4.50

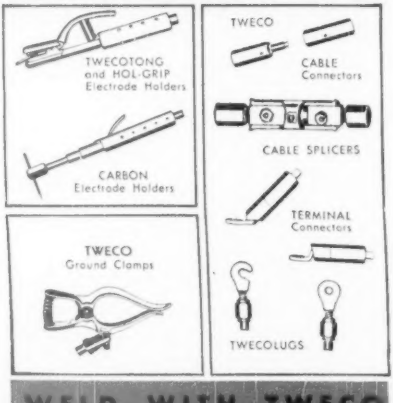
It is important to have a solid ground connection that is quickly removable and easily attached again to the work. INSIST on TWECO Ground Clamps for this purpose. TWECO Ground Clamps have powerful jaw grip for positive contact, easy-on, easy-off grounding. Junior and Senior clamps have a heavy copper braid between the jaws—welded-in so both will carry current. Insulated springs. High copper alloy construction. A size for every work requirement.

TWECO GROUND CLAMP PRICES

Model	Amp. Capacity	Cable Capacity	Price
Midget	125 Ampere	No. 6, 4, 2	$1.50
Jr.	300 Ampere	4, 2, 1, 1/0	3.00
Sr.	500 Ampere	1/0 thru 4/0	4.50

Write for Quantity prices. They save you 10 to 27%

FROM THE WELDING MACHINE TO THE ELECTRODE AT MAXIMUM EFFICIENCY



WELD WITH TWECO

Write for Twecolog #7 giving data and prices on the complete TWECO line of electrode holders, ground clamps and cable connections for electric welding.

Tweco PRODUCTS COMPANY

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